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System Manual

BreezeACCESS LB
System Manual

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The system equipment has been tested and found to comply with the limits for a class A digital device, pursuant to EN300385 rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in commercial, business and industrial environments. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the user's own expense.

R&TTE Compliance Statement

This equipment complies with the appropriate essential requirements of Article 3 of the R&TTE Directive 1999/5/EC.

Safety Considerations

For the following safety considerations, "Instrument" means the BreezeACCESS LB units' components and their cables.

Caution

To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

Line Voltage

Before connecting this instrument to the power line, make sure that the voltage of the power source matches the requirements of the instrument.

Radio

The instrument transmits radio energy during normal operation. To avoid possible harmful exposure to this energy, do not stand or work for extended periods of time in front of its antenna. The long-term characteristics or the possible physiological effects of Radio Frequency Electromagnetic fields have not been yet fully investigated.

Outdoor Unit and Antenna Installation and Grounding

Be sure the outdoor unit, the antenna and the supporting structure are properly installed to eliminate any physical hazard to either people or property. Verify that the outdoor unit and the antenna mast (when using external antenna) are grounded so as to provide protection against voltage surges and static charges. Make sure that the installation of the outdoor unit, antenna and cables is performed in accordance with all relevant national and local building and safety codes.

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Chapter 1

About this Guide

Scope of this Manual

This system manual describes the BreezeACCESS LB Wireless Broadband System Release 1.0, and how to install, operate and manage the system components.

This manual is intended for technicians responsible for installing, setting-up and operating the BreezeACCESS LB system, and for system administrators responsible for managing the system.

This manual contains the following chapters:

- **Chapter 1, About This Guide:** Explains how to use the manual and presents important information.
- **Chapter 2, Introduction:** Describes the BreezeACCESS LB system and its components.
- **Chapter 3, Installation:** Describes how to install BreezeACCESS LB system components.
- **Chapter 4, Commissioning:** Describes how to configure system parameters.
- **Chapter 5, Diagnostics and Troubleshooting:** Provides basic diagnostics and troubleshooting procedures to help solve problems that may occur with the BreezeACCESS LB system.
- **Chapter 6, Wireless Broadband:** Overview of the design and benefits of the Wireless Broadband network architecture.
- **Appendix A, Glossary of Terms:** Provides an at-a-glance summary of the terms used in this system manual.
- **Appendix B, Peak Power Spectral Density:** Provides the power spectral density as measured for the BreezeACCESS LB system.
- **Appendix C, CLI Commands:** Provides a diagram how to assemble the antennas, and vertical mount bracket.
- **Appendix D, Support for TDM using Third Party Units:** Provides an at-a-glance summary of the terms used in this system manual.
- **Appendix E, Antenna Assembly:** Provides a diagram how to assemble the antennas, and vertical mount bracket.

Important Safety Information

1. Read this System Manual and follow all operating and safety instructions.
2. Keep all product information for future reference.
3. This product is supplied with a grounding power plug. Do not defeat this important safety feature.
4. The power requirements are indicated on the product-marking label. Do not exceed the described limits.
5. Always replace the fuse with the correct type and current rating.
6. Position the power cord to avoid possible damage, and do not overload wall outlets.
7. Do not place this product on or near a direct heat source, and avoid placing objects on the BreezeACCESS LB NI-01 Indoor unit.
8. Do not operate this device near water or in a wet location.
9. Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners. Disconnect the power before cleaning.
10. Protect the unit by disconnecting the power if it is not used for long periods of time.
11. Locate the BreezeACCESS LB NI-01 Indoor unit on a stable horizontal surface or mount it securely in a 19" Telco rack.
12. The BreezeACCESS LB RE-01 Outdoor unit must not be located near power lines or other electrical power circuits.
13. The BreezeACCESS LB RE-01 Outdoor unit must be properly grounded to protect against power surges and accumulated static electricity. It is the user's responsibility to install this device in accordance with Section 810 of the National Electrical Code, ANSI/NFPA No. 70-1984 or Section 54 of the Canadian Electrical Code. These codes describe correct installation procedures for grounding of the LB RE-01 unit, mast, lead-in wire and discharge unit, location of discharge unit, size of grounding conductors and connection requirements for grounding electrodes. It is recommended that the installation of the LB RE-01 be contracted to a professional installer.

The following symbols may be encountered during installation or troubleshooting. These warning symbols mean *danger*. Bodily injury may result if you are not aware of the safety hazards involved in working with electrical equipment and radio transmitters. Familiarize yourself with standard safety practices before continuing.

Magnetic Radiation

High Voltage

Important Service Information

1. Refer all repairs to qualified service personnel. Do not remove the covers or modify any part of this device.
2. Disconnect the power to this product and return it for service if the following conditions apply:
    a) The unit does not function after following the operating instructions outlined in this manual.
    b) Liquid has been spilled, a foreign object is inside or the LB NI-01 Indoor unit has been exposed to rain.
    c) The product has been dropped or the housing is damaged.
3. Ensure that only parts that are specified by the product manufacturer are used for replacement.
4. Locate the serial number of the LB NI-01 Indoor unit, Antenna, LB RE-01 Outdoor unit and record these on your registration card for future reference. Use the space below to affix serial number stickers. Also record the MAC address, located on the back of the LB NI-01 Indoor unit.

Product Information

LB NI-01 Indoor unit S/N: _____ MAC Address:_____

LB RE-01 Outdoor unit S/N: _____ Model #: _____

Antenna Type: 23 dBi ☐ or 28 dBi ☐ Antenna S/N:_____

Chapter 2

Introduction

About This Chapter

This chapter is comprised of the following sections:

- **Introducing BreezeACCESS LB**, page 2-2, provides a general introduction of the entire BreezeACCESS LB system.
- **System Components** page 2-2, describes the highlights of the BreezeACCESS LB system components.
- **Networking Equipment**, page 2-2, describes the standard network connections used by the BreezeACCESS LB system.
- **Management Systems**, page 2-3, introduces the management and monitoring interface for the BreezeACCESS LB system.
- **Specifications**, page 2-3, provide system specifications for the BreezeACCESS LB system components.

Introducing BreezeACCESS LB

The BreezeACCESS LB is a high-performance, high-speed wireless Ethernet bridge system providing a scalable multi-service platform from a common equipment infrastructure and management system.

The BreezeACCESS LB system operates in the unlicensed UNII band of 5.8 GHz and includes advanced technologies to address any potential inter-cell interference issues. The system also features adaptive modulation in both directions for automatic selection of modulation schemes, including BPSK, QPSK, 16 and 64 QAM to maximize data rate up to 72 Mbps, and improve spectral efficiency.

The BreezeACCESS LB system is a Class A digital device for use in a commercial, industrial or business environment.

System Components

The BreezeACCESS LB system is comprised of an Indoor Unit (LB NI-01) and an Outdoor Unit (LB RE-01).

The LB RE-01 Outdoor Unit can be equipped with a narrow beam antenna to provide high directivity for long-range operations up to 30 miles (50 km) in line of sight (LOS) conditions, and up to 6 miles (10 km) in NLOS conditions.

The LB NI-01 Indoor unit provides the interface to the customer's equipment. The customer's data equipment is connected via a standard IEEE 802.3 Ethernet 10/100BaseT (RJ 45) interface. The LB NI-01 Indoor unit is connected to the Outdoor Unit via a 75-ohm coaxial Intermediate Frequency (IF) cable. This cable carries 815 MHz IF signals between the Indoor and the Outdoor Units, and also transmits management and control signals between the Indoor and Outdoor Units. In addition, this cable transmits power (24 VDC) from the Indoor Unit to the Outdoor Unit.

Networking Equipment

The BreezeACCESS LB system point-to-point is connected to the backbone through standard data communication and telecommunication equipment. The 10/100BaseT ports of the system can be connected directly to a multi-port router or to an Ethernet switch connected to a router.

Management Systems

BreezeACCESS LB system components can be managed using a standard interface. All operator communications with the LB NI-01 Indoor unit are achieved over the Ethernet port, using hypertext transfer protocol (HTTP). In addition, the LB supports Telnet server, SNMP and Console Port command line interface (CLI) communication protocol. This offers the advantage of allowing the operator to access and control the BreezeACCESS LB units remotely from any geographical location.

Specifications

Radio

Frequency	5.725 – 5.825 GHz (UNII Band)									
Radio Access Method	TDD (Time Division Duplex)									
Channel Spacing	20 MHz									
Channel Center Frequency	Ch.	1	1A	2	2A	3	3A	4	4A	5
	Freq.	5.735 GHz	5.745 GHz	5.755 GHz	5.765 GHz	5.775 GHz	5.785 GHz	5.795 GHz	5.805 GHz	5.815 GHz
Antennas	23 dBi, 9°, vertical / horizontal polarization 28 dBi, 4.5°, vertical / horizontal polarization									
Range	Up to 30 miles / 50 km line-of-sight (LOS)									
Antenna Port	50 ohm									
Output Power (antenna port)	Min: -5 dBm Max: +20 dBm									
RF input at receiver:	Max: -15 dBm									
Over the Air Rate	72 Mbps									
Modulated Burst Data Rate	6, 9, 12, 18, 24, 36, 48, 54 Mbps									
Sensitivity, typical (dBm at antenna port, BER 1E10-6)	Data rate Mbps	6	12	18	24	36	48	54		
	dBm	-86	-84	-83	-81	-77	-70	-65		
	Modulation	BPSK	QPSK	QPSK	16 QAM	16 QAM	64 QAM	64 QAM		
Modulation	OFDM modulation, BPSK, QPSK, 16 QAM, 64 QAM									
Coding Rate	1/2, 3/4 and 2/3									
OFDM symbol rate	4 us (microseconds) including guard interval.									

MAC	Point to point Automatic Repeat Request (ARQ) error correction Concatenation/Fragmentation

Data Communication

Standard Compliance	IEEE 802.3 CSMA/CD
VLAN support	Transparent to IEEE 802.1q
Layer-2 Traffic Prioritization	IEEE 802.1p prioritization
Layer-3 Traffic Prioritization	Transparent to IP ToS according to RFC791

Outdoor Unit to Indoor Unit Communication

IF Frequency	815 MHz
IF cable Impedance	75 ohm
Maximum IF cable Attenuation	25 dB @2.5 GHz
Cable Length	Maximum length up to 250 ft (76m) using RG6U Maximum length up to 500 ft (152m) using RG11U Multiplexed IF, DC power, control (Tx/Rx, AGC, APC)

Configuration and Management

Local & Remote Management	HTTP Web Interface Local Console Port SNMP Telnet Command Line Interface (CLI)
Remote Management Access	From Wired LAN, Wireless Link
Security	Proprietary 64-bit encryption (Data)
Software upgrade	Via TFTP

Interfaces

Interface	**Outdoor Unit**	**Indoor Unit**
IF	F-Type connector	F-type connector
Antenna	N-Type connector	N/A
Ethernet	N/A	Auto-sensing 10/100Base-T (RJ-45) with 4 LEDs

Interface	Outdoor Unit	Indoor Unit
Power	24 VDC from indoor unit via the IF cable	AC jack

Electrical, Mechanical and Environmental

	LB RE-01 Outdoor Unit	LB NI-01 Indoor Unit
Power	24 VDC, 1.4A via the IF cable	110/220 VAC, 50/60 Hz, 39 W max.
Mechanical	12” x 4.6” x 4” 304.8 mm x 116.8 mm x 101.6 mm	17” x 12” x 1.75” 431.8 mm x 304.8 mm x 44.45 mm
Wind Loading	137 mph 220 km/hr	N/A
Operating Temperature	-40°F to +140°F -40°C to +60°C	32°F to 131°F 0°C to +55°C
Operating Humidity	5%-95% non condensing, Weather protected	5%-95% non condensing
Component Weights	LB NI-01 Indoor unit ……...……. 2.0 kg 3.3 lb LB RE-01 Outdoor unit …… 3.6 kg 8.0 lb Vertical Mast Bracket Kit ……..…..…….. 4.5 kg 10.0 lb Vertical Mast Bracket Hardware Kit …… 0.5 kg 1.1 lb Antenna, 28 dBi, 4.5° …… 5.0 kg 11.0 lb Antenna, 23 dBi, 9° ……...…… 1.0 kg 2.2 lb IF Cable, F Male/F Male, RG6, Messenger Wire, 100 ft…..…… 1.3 kg 2.9 lb	

Standards Compliance, General

Type	Standard
EMC	CISPR 22 Class B under ETSI 300 386
Safety	EN 60950
Environmental	IC RSS210
Radio	FCC Part 15 Subpart E

23 dBi, 9 Degree Antenna Specifications

Type	Planar Array
Regulatory Compliance	ETSI EN 302 085 V1.1.2 (2001-02)
Electrical	
Frequency Range	5.15-5.35 GHz and 5.725-5.875 GHz
Gain	23 dBi (min)
VSWR	1.7:1 (max)
3 dB BW	9° (typical)
Polarization	Linear (Vertical or Horizontal)
Cross Polarization	-28 dB (max)
Side lobe Level	ETSI EN 302 085 V1.1.2 (2001-02) Range 1TS1- TS3
F/B Ratio	-32 dB (max)
Lightning Protection	DC Grounded
Mechanical	
Dimensions	(L x W x D) 12 x 12 x 1 in / 305 x 305 x 25 mm
Weight	3.3 lb / 1.5 kg
Connector	N-Type Female
Temperature (operating)	-45°C to +70°C / -49°F to + 158°F
Wind Load (Survival)	137 mph / 220 km/hr
Radial Ice Load	1 in / 25 mm

28 dBi, 4.5 Degree Antenna Specifications

Type	Planar Array
Regulatory Compliance	ETSI EN 302 085 V1.1.2 (2001-02)
Electrical	
Frequency Range	5.25-5.85 GHz
Gain	28 dBi (min)
VSWR	1.5:1 (typical) 1.7:1 (max)
3 dB BW	4.5° (typical)
Polarization	Linear (Vertical or Horizontal)
Cross Polarization	-28 dB (max)
Side lobe Level	ETSI EN 302 085 V1.1.2 (2001-02)
F/B Ratio	-40 dB (max)
Lightning Protection	DC Grounded
Mechanical	
Dimensions	(L x W x D) 24 x 24 x 2.2 in / 600 x 600 x 55 mm
Weight	11 lb / 5 kg (max)
Connector	N-Type Female
Temperature (operating)	-45°C to +70°C / -49°F to + 158°F
Wind Load (Survival)	137 mph / 220 km/hr
Radial Ice Load	1 in / 25 mm

Chapter 3
Installation

About This Chapter

This chapter is comprised of the following sections:

- **Installation Requirements**, page 3-2, provides the list of supplies and materials required to install each BreezeACCESS LB system component. In addition, a glance of the indoor and outdoor units is provided, and also description of the unit's LED's.
- **Equipment Location Guidelines**, page 3-6, provides information on the best locations to deploy the BreezeACCESS LB components in order to achieve the optimal reception and transmission quality.
- **Installing the Indoor Unit**, page 3-9, describes how to install the Indoor Unit
- **Installing the Outdoor Unit and Antenna**, page 3-9, describes how to mount the Outdoor Unit, connect the antenna, IF and ground cables.
- **Aligning the Antenna**, page 3-15, provides an illustrated description of how to align the antenna.

Installation Requirements

This section describes all the supplies required to install the BreezeACCESS LB system components and the items included in each installation package.

Packing List: BreezeACCESS LB System

The BreezeACCESS LB system comes packaged with the following major items:

- BreezeACCESS LB NI-01 Indoor unit
- BreezeACCESS LB RE-01 Outdoor unit:
  - Antenna (28 or 23 dBi)
- Antenna Mounting Bracket:
  - Vertical (accommodates 28 or 23 dBi antennas)
- Power Cord and outdoor IF Cable (100 ft. / 30.5 m)
- CD
- Quick Installation Guide

A complete list of items included in the system is available on the packing list included.

The Indoor Unit at a Glance

The front panel of the LB NI-01 Indoor unit includes a LAN interface and three main status indicators: System, Wireless, and Ethernet. The rear of the LB NI-01 Indoor unit includes the power cord connector and an F-Type female connector for the IF cable.

At power up, an LED power-up sequence occurs as follows:

All four Ethernet LEDs light for one second, then individual Ethernet LEDs blink twice in the following order: 100, FD, Col, Link. The Fault LED lights for approximately four seconds, and then turns off. The two Wireless LEDs remain off for approximately five seconds, and then resume their normal state.

For a detailed description of the status indicators on the front panel, see the Diagnostics section of this manual, in section 5-2.

System Status Indicators

The System portion of the front panel features a recessed reset switch and two LEDs (Pwr and Fault), as shown in the figure below.

Figure 1: Front Panel – System

Reset – depressing the "Reset" button recessed in the front panel can hard reset the system. The reset button is used to reactivate the BreezeACCESS LB unit in the event that it is functioning improperly or is in a state of suspension.

Pwr – The "Pwr" LED lights solid and green when the AC power is properly applied to the LB NI-01 Indoor unit. In the event of internal power supply failure, if the cord is disconnected, or if the fuse is blown, the "Pwr" light will not illuminate

Fault – The "Fault" LED lights solid red when a serious fault is detected within the system.

Wireless Status Indicators

The Wireless portion of the front panel features two LEDs, Link and Signal, as shown below.

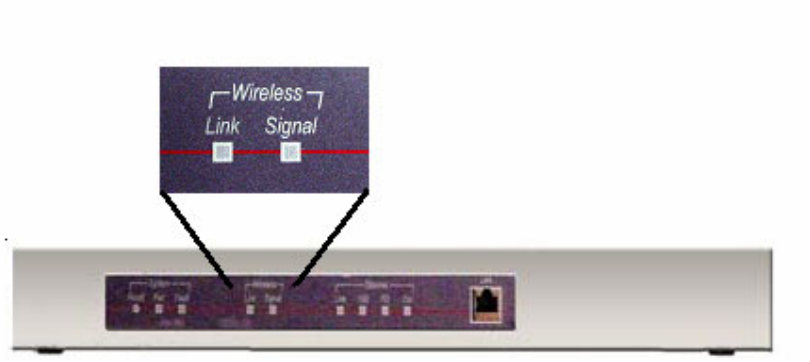


Figure 2: Front Panel – Wireless

Link – The "Link" LED lights solid and green when the radio link to the remote BreezeACCESS LB unit is established. The LED will turn off if the link is lost.

Signal – The "Signal" LED lights solid green if the system is operating at the configured Modulated Burst Rate. See section 5 for a detailed description.

Ethernet Status Indicators

The Ethernet portion of the front panel display comprises four main LEDs: Link, 100, FD and Col, as shown below.

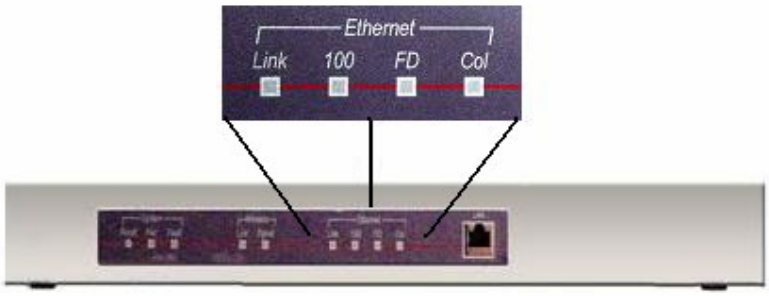


Figure 3: Front Panel – Ethernet

Link – The "Link" LED illuminates solid and green when the Local Area Network (LAN) connection is established, and there is no traffic. The Link

LED will flash when the Local Area Network (LAN) connection is established, and there is traffic.

100 – The "100" LED lights solid and green when the Ethernet port is operating at 100 Mb/s. The LED will not illuminate if the port is operating in 10 Mb/s mode. The Ethernet port automatically selects the speed through auto-negotiation with either the host computer/server or router/switch.

FD – The "FD" LED illuminates solid and green when the LAN connection is operating in Full Duplex mode. The system automatically selects the duplex mode through auto-negotiation with the host computer or switch.

Col – The "Col" LED flashes in amber when collisions are detected on the Ethernet port.

The LAN Interface

The LAN interface is a 10/100 Base-T Ethernet port, which is used to connect the LB NI-01 Indoor unit to either the core network or to a host computer. A router or switch is often used to complete the connection to the core network, as shown in the figure below. Note that different cables are required for connection to a hub/switch/router or host computer. See Section 5.4 of this manual for more information regarding installation of the LB NI-01 Indoor unit.

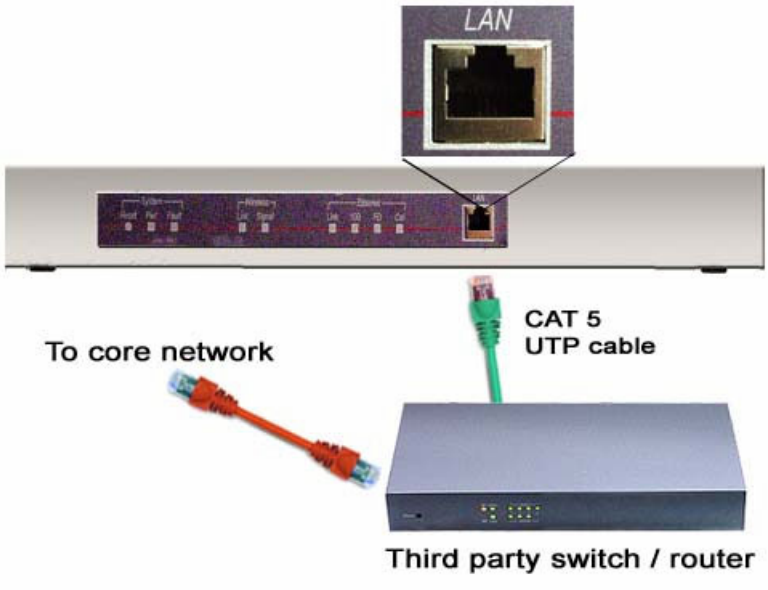


Figure 4: LAN Interface

The Outdoor Unit & Antenna at a Glance

Special brackets for outdoor unit and vertical mount bracket for antenna (Figure 5) are provided with the system.

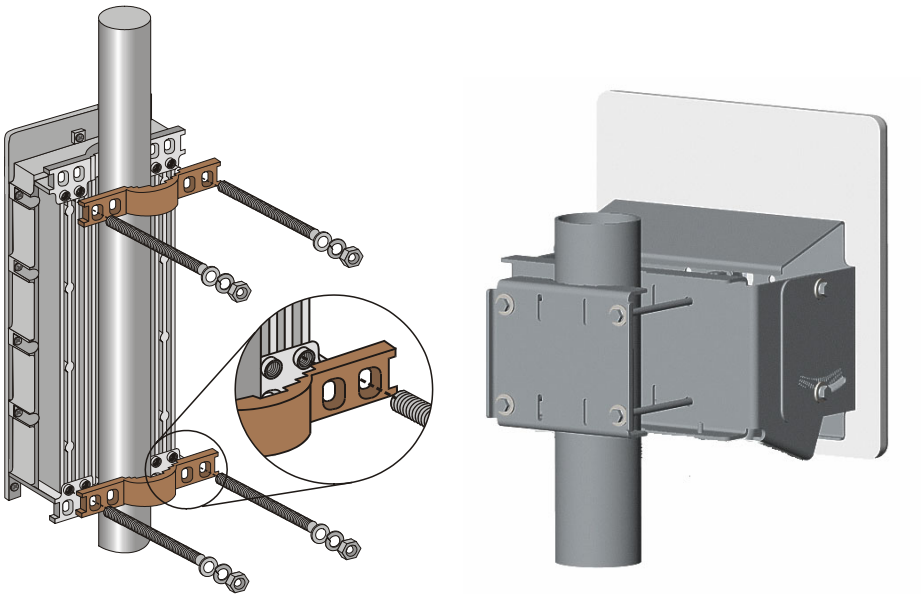


Figure 5: Outdoor Unit and Antenna with Vertical Mount

The vertical mount bracket can accommodate 1 ¾" to 4 ½" (4.45 cm – 11.45 cm) masts found on many commercial tower installations

Before connecting the BreezeACCESS LB system, it is important to review the safety tips provided at the beginning of this manual.

Equipment Location Guidelines

The first step in installing the BreezeACCESS LB system is to conduct a general site survey. Although the installation steps are relatively straightforward, they do involve some construction and electrical work, which is best performed by a professional installer. The following site survey steps should be followed:

Determine the optimum location. The first key step in the deployment exercise is to determine and identify building candidates that can be used to support the link. A critical parameter to consider is the range at which the two BreezeACCESS LB units are required to operate. Range performance is determined by empirical formulas that consider a number of equipment and environmental factors described in Chapter 6 of this manual. Ensure that the installation sites meet these range performance

requirements before moving to the next step. You may use the BreezeACCESS LB's Link Budget Tool to determine the expected performance of the link. See Section 6-5 for more information.

Verify the accuracy of any building drawings/blueprints that may be available. The installation process may require penetrating the building to run the IF cable between the outdoor and indoor units. In this regard, it is imperative that the blueprints and/or drawings of the building are up to date and accurate. It may also be possible for the IF cable to be installed on the outside of the building leading to the antenna location on the roof of the building.

Identify the best path for the link. For maximum performance, it is recommended to mount the antenna in a location where there is line of sight to the remote BreezeACCESS LB unit. If possible, the antenna should be positioned such that there is maximum clearance within the first Fresnel zone of the direct path. Refer to Chapter 6 for a full description of Fresnel zone clearance and its impact on signal propagation. The best means of achieving Fresnel zone clearance is to mount the antennas as high as possible, on either a tall building or tower, as shown in Figure 6. (Vertical mount system is shown).

The BreezeACCESS LB system is also designed to operate in near-line-of-sight (NLOS) conditions, as a result of the OFDM technology incorporated in the system. Under NLOS conditions, the best method of obtaining a proper RF link is to evaluate different antenna orientations and choosing the one with the best Signal to Noise (SINADR) ratio and highest Received Signal Strength (RSSI) value. Often, this can be achieved by introducing an RF multipath condition by orienting the antennas towards a structure in sight of both the local and remote antennas. If the obstruction in the path is not exceptionally high, it may be possible to aim both antennas near the top of the obstruction.

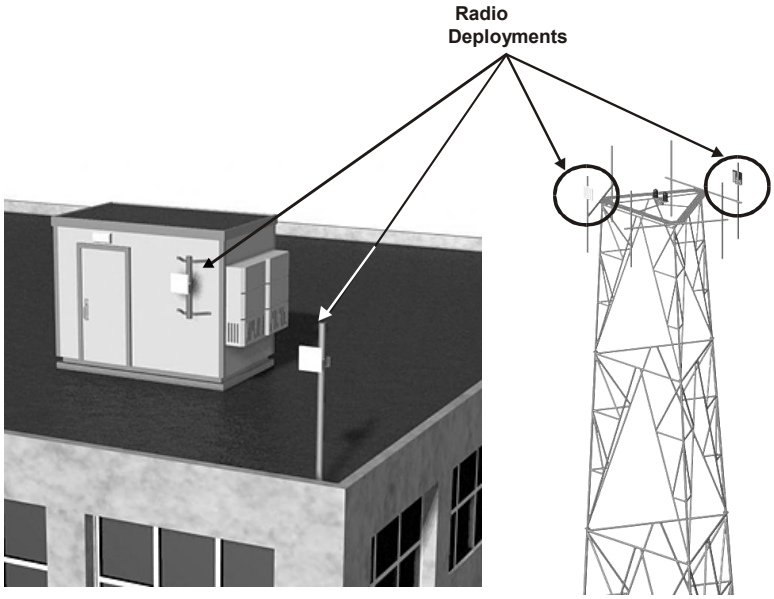


Figure 6: Radio Deployment Options

Identify potential sources of RF interference. Test for possible RF interference on the rooftop or tower by utilizing appropriate test equipment. RF interference arises from any other wireless system operating within the same frequency band as the BreezeACCESS LB system. Note that the BreezeACCESS LB system supports nine different overlapping channels within the UNII band and has the ability to use up to five of these channels at any one cell site; there is, therefore, some flexibility in addressing or avoiding interference should other transmitters in relatively close proximity present problems.

This section of the manual presents a basic overview of the steps required to install the LB NI-01 Indoor unit, LB RE-01 outdoor unit, antenna and associated equipment.

Figure 7 below illustrates the primary system components and cables. The power cord connects to a 110/220/240 VAC North American standard power outlet, while the CAT 5/UTP cable (not included) connects the LB NI-01 Indoor unit to the data network via a standard 10/100BaseT Ethernet connection. The provided IF cable connects the LB NI-01 Indoor unit (located indoors) to the LB RE-01 Outdoor unit (located outdoors), and carries the transmitted and received signal, DC power for the LB RE-01 Outdoor unit, as well as control and reference signals. Note that the IF cable provided is meant for exterior use, and should be used for only minimal interior runs to connect to the LB NI-01 Indoor unit. Also note that the BNC and serial connectors are for future use.

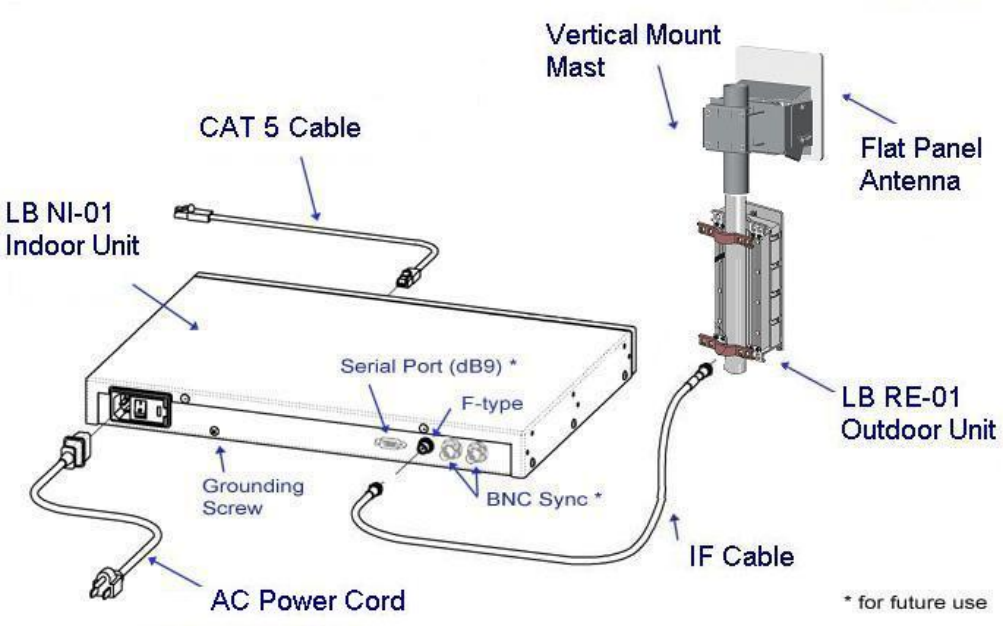


Figure 7: BreezeACCESS LB System Installation

Installing the Indoor Unit

Once the LB NI-01 Indoor unit and the LB RE-01 outdoor unit are connected, the LB NI-01 Indoor unit is ready to be installed and configured. The Ethernet data rate is determined automatically, depending on the type of device connected to the system.

If the LB NI-01 Indoor unit is used for connection to a core network, the network device is likely to be a router, hub, or switch as shown in Figure 8. In this configuration, a crossover Ethernet cable is required to connect between the LB NI-01 Indoor unit and the network device.

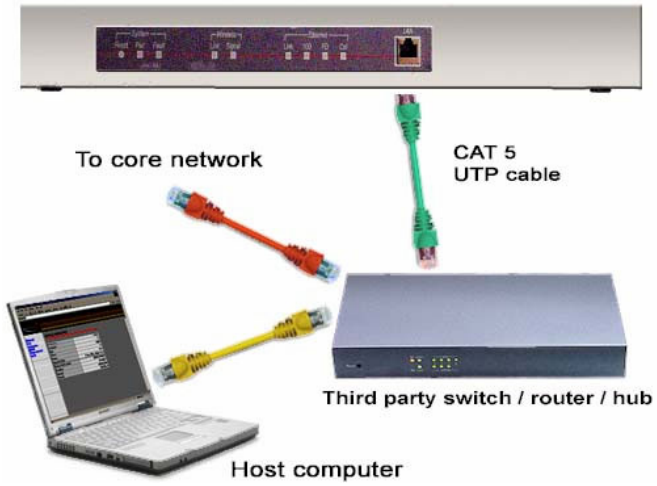


Figure 8: Indoor Unit Connected To Switch/Router/Hub

The LB NI-01 Indoor unit may also be connected directly to the host computer, as shown in Figure 9. In this configuration, a straight-through CAT 5/UTP cable is required to complete the connection.

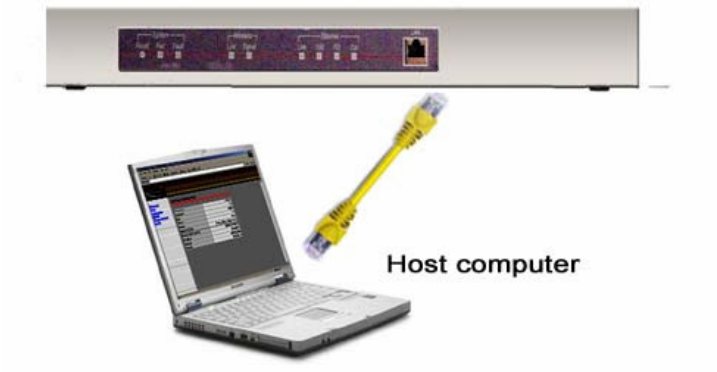
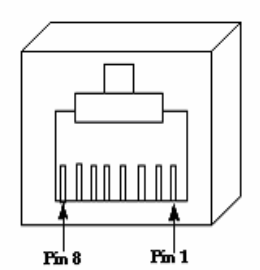


Figure 9: Indoor Unit Connected To Host Computer

To help you establish other implementations that are not addressed in this manual, Figure 10 provides an illustration of the pin-out for the LB NI-01 Indoor unit LAN interface.

Warning: do not connect a telephone cable to the LB NI-01 LAN interface, as this will damage the LB NI-01 Indoor unit.



RJ-45 Jack Face

Jack Pin	Function
1	Rx +
2	Rx -
3	Tx +
6	Tx -

Figure 10: Indoor unit LAN Ethernet Port Pin-out

Now connect the AC cord to the 110/220/240 VAC outlet and turn on the LB NI-01 using the toggle switch in the rear of the unit. The system "Pwr" LED should illuminate green to indicate power to the unit. The system is now ready to be configured. If the Pwr LED is not on and/or the "Fault" LED illuminates red, there is a problem with the LB NI-01. Refer to the diagnostics in Section 5, for further details on system faults.

Installing the Antenna and Outdoor Unit

Once the site survey has been completed and the exact location for the antenna identified, the next step is to assemble and mount the antenna and outdoor unit onto a building structure, pole or tower.

Note there is an arrow on the back of the antenna, which must point in the same direction for both the local and remote systems to ensure proper polarization when the antenna is deployed (see Figure 11 below). Ensure the proper polarization is used for the antenna before attaching the mounting bracket in the next step.

The vertical mount bracket is installed first. The antenna and mounting brackets have been designed to withstand strong winds; it is imperative that all hardware for the mounting brackets be securely fastened to avoid any movement that could induce a misalignment. *Refer to Appendix E for more details on mounting antenna and vertical mount bracket.*

The Outdoor unit is then mounted using the special brackets as shown in Figure 13. Note the outdoor unit must be connected to the antenna via the short RF cable provided, using the N connector.

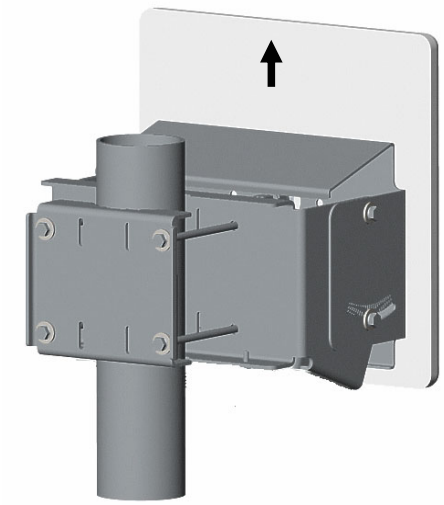


Figure 11: Antenna Polarization Arrow

For building mounts, ensure the surface to which the mounting bracket will be attached is structurally sound, flat and vertical (use a level). Ensure that the installation can withstand wind loading.

Installing the Outdoor Unit

The following sections describe how to install the Outdoor Unit, including pole mounting the unit, grounding and IF cables.

The Outdoor Unit can be mounted on a pole using one of the following options:

- Special brackets and open-ended screws are supplied with each unit. There are two pairs of screw holes on the back of the unit, enabling the special brackets to be mounted on diverse pole widths.
- U-bolts – Size "A" fit the inner installation holes for poles of up to 2 inches.
- U-bolts – Size B fit the outer installation holes for poles up to 3 inches.
- Special grooves on the sides of the unit enable the use of metal bands to secure the unit to a pole. The bands must be 9/16 inches wide and at least 12 inches long. The metal bands are not included with the installation package.

Figure 12 shows the locations of the U-bolt holes, band grooves and screw holes on the back, top and bottom of the Outdoor Unit.

NOTE:

Be sure to install the unit with the bottom panel, which includes the IF connector, facing downward.

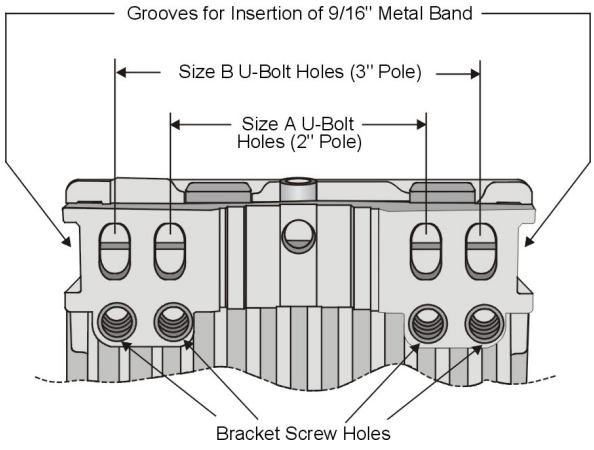


Figure 12: Holes/Grooves/Screw Holes

Figure13 below illustrates the method of installing an Outdoor Unit on a pole, using the brackets and open-ended screws.

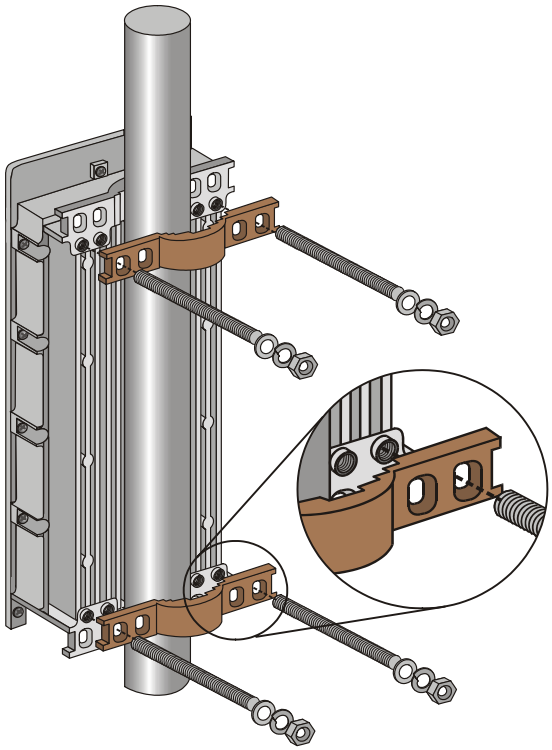


Figure 13: Installation Using the Special Brackets

NOTE:

Be sure to insert the open-ended screws with the grooves pointing outward, since these grooves enable you to use a screwdriver to fasten the screws to the unit.

Connecting the Antenna Cable

Connect an RF cable between the antenna and the antenna connector in the outdoor unit. The antenna connector of the outdoor unit is located on the top panel.

Connecting the Ground and IF Cables

The ground terminal, which is marked with the ⏚ symbol and the IF cable connector (marked IF) are located on the bottom panel of the unit, as shown in Figure 14.

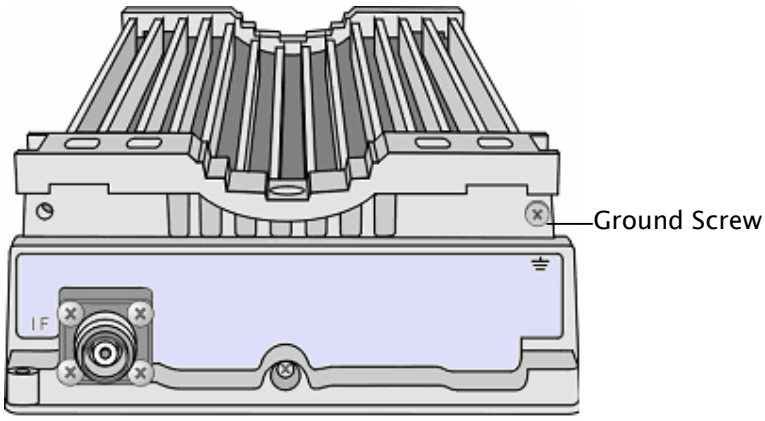


Figure 14: Outdoor Unit top Panel

To connect the ground cable:

1. Connect one end of a grounding cable to the ground terminal and tighten the ground screw firmly.
2. Connect the other end of the ground cable to a ground connection.

NOTE:
It is recommended that you switch OFF the power of the Indoor Unit prior to connecting or disconnecting the IF cable to or from the Outdoor Unit.

Running the IF cable

The system is shipped with a 100 foot (30.5 m) length of RG6 IF cable to connect the LB RE-01 outdoor unit, and LB NI-01 Indoor unit. The IF cable carries the transmitted and received signal, DC power for the outdoor unit, and control signals. One hundred feet is the mandatory *minimum* length; if a longer outdoor run is required, it is recommended that a single length of the appropriate cable be used; coupling the provided 100 ft cable to another length will result in increased attenuation. Refer to the cable requirements in the Specifications section of this manual.

The following steps define the cable installation process:

1. Run the cable alongside the antenna pole. The IF cable is equipped with 75 ohm male F-type connectors at both ends. Ensure the cable is running downward as shown to prevent water from accumulating on the connector. The cable should be fastened to the pole to prevent movement or damage to the connector.
2. Connect the F-type male cable connector to the female connector on the outdoor unit. The connector should then be weatherproofed with a standard weatherproofing material for outdoor RF installations.
3. The provided IF cable is for exterior use. It is recommended that the cable terminate at the exterior wall using a grounding block, and that interior grade cable be used to connect the LB NI-01 Indoor unit to the grounding block according to local codes. Additional lightning

protection can be used to enhance the protection of the indoor unit, and outdoor unit from sudden electrical surges. Suitable lightning arrestors can be purchased through any of Alvarion's system integrators.

4. Connect the IF cable to the F-type female connector located on the back of the LB NI-01 Indoor unit. The connector should be tightened finger-tight and then tightened an additional 1/8 of a turn.

Aligning the Antenna

Once the antenna is mounted and the LB NI-01 Indoor unit is installed, the antenna must be aligned in both the azimuth and elevation planes. Elevation alignment is accomplished by loosening the two bolts attached to the mounting bracket, as shown in Figure 15 below, and angling the antenna so it is aligned towards the remote BreezeACCESS LB unit.

The azimuth alignment is accomplished by loosening the bolts on the antenna bracket, and rotating the antenna until alignment is achieved. For basic tuning using actual signal strength, an alignment "buzzer" (intermittent tone sweep generator) is available in the LB RE-01 Outdoor unit. Faster repetitions of the tone sweep indicate better alignment. The buzzer is enabled via the software interface described in section 4.

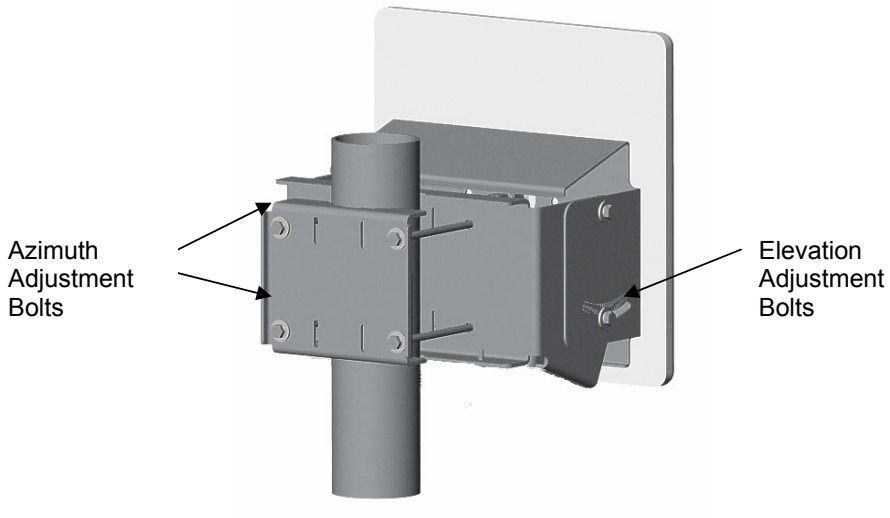


Figure 15: Aligning the Antenna - Vertical Mount

NOTICE

1. The BreezeACCESS LB System is used as a fixed wireless Ethernet bridge that is to be professionally installed by a trained professional installer or sub-contractor.
2. For compliance with FCC RF exposure requirements, the transmitting antenna is required to be mounted outdoors on the building roof or antenna tower and located at a distance of more than 1.5 meters (5 feet) from the transmitting antenna to any person's body.
3. The BreezeACCESS LB System is certified by the USFCC and Industry Canada with 5.8 GHz Directional Antennas, Alvarion Part Numbers 858109 (28 dBi Gain) and 858110 (23 dBi).

Chapter 4
Commissioning

About This Chapter

This chapter is comprised of the following sections:

Preliminary Configuration

After completing the installation process, as described in the preceding chapter, the basic parameters must be configured to ensure that the unit operates correctly. Once the basic parameters have been configured, additional parameters can be remotely configured via the Ethernet port or the wireless link using hypertext transfer protocol (HTTP) management, Telnet, SNMP or by using the Local Console port RS-232 (DB9)

Note for the initial setup, the operator must connect the host computer locally to the LB NI-01 unit as shown in figure 9.

Local Unit Management

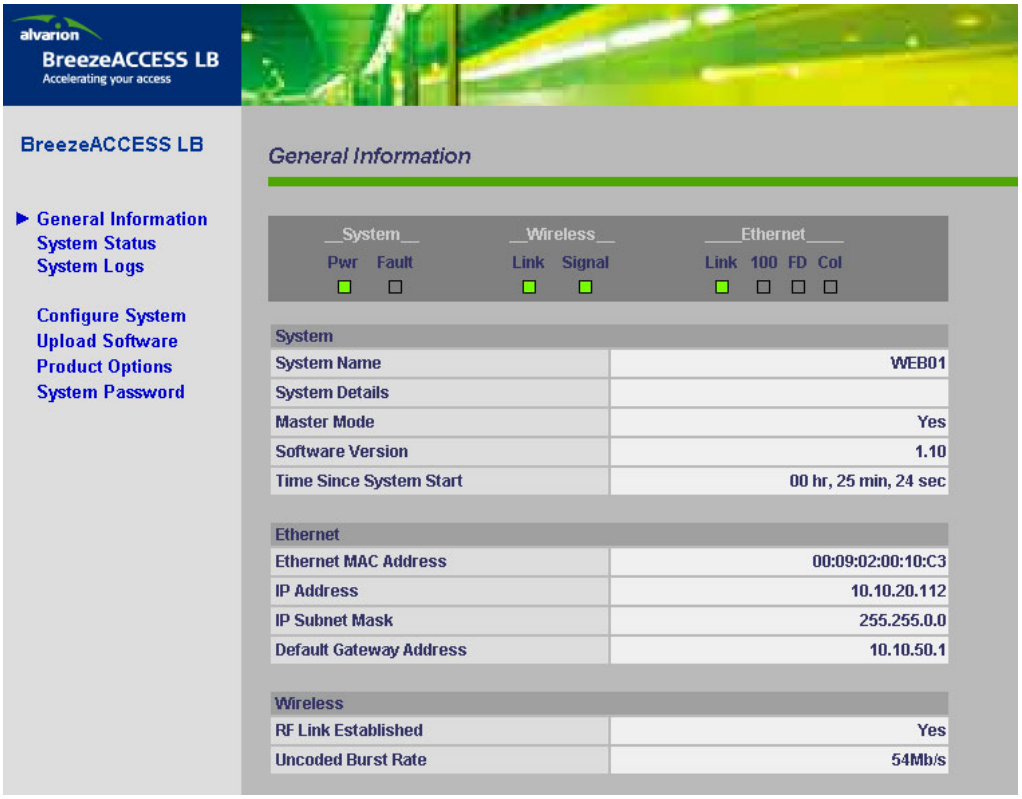
This section describes the procedures for configuring and operating the BreezeACCESS LB NI-01 Indoor unit.

System Configuration and Operation via the Web Interface

1. Connect a PC to the Ethernet port, using a straight cable to connect to the LB NI-01 indoor unit and a crossed cable to connect to network device (switch, router, hub). LB NI-01 Indoor unit as shown in Figure 8.
2. Configure the PC's IP parameters to enable connectivity with the unit.
3. Log on to the LB NI-01 General Information home page from a web browser. Microsoft Internet Explorer is recommended, as it enables context help when placing the mouse pointer over any item.

Enter the system's default IP address - http://192.168.25.2.

Entering the IP address above will call up the General Information page, as shown below. The items on this page are described in detail in section 4.3 below. If the General Information page is not accessible, check for possible text entry errors; otherwise refer to the Diagnostics and Troubleshooting section of this manual (section 5) for further assistance.



It will be necessary to enter a valid user name and password. Note that a valid Administrator password is required to enter any of the following pages:

- Configure System
- Upload Software
- System Password
- BreezeACCESS LB Options
- Reset Statistics button on System Status

An example of the user name and password screen is shown in Figure 16. The default value (set from the factory) for both "user name" and "password" is **admin**. This login allows access to all screens. The default value (set from the factory) for both the user name and password for the User is **user**. This login denies access to the Configuration, Upload, and BreezeACCESS LB Options screens. Refer to the System Password screen to change the password for future sessions. If the password is changed, record it in a secure location for future reference. Note that the user name cannot be changed from "admin".

Figure 16: User Name and Password Dialog

The main menu on the left includes the following links:

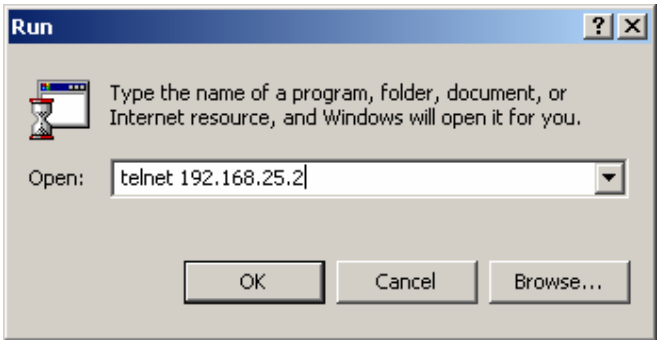
- General Information
- System Status
- Configuration
- Upgrade
- Change Password
- Registration
- Log File

The General Information page does not accept input from the user. Data shown on this page may be modified via the Configuration page.

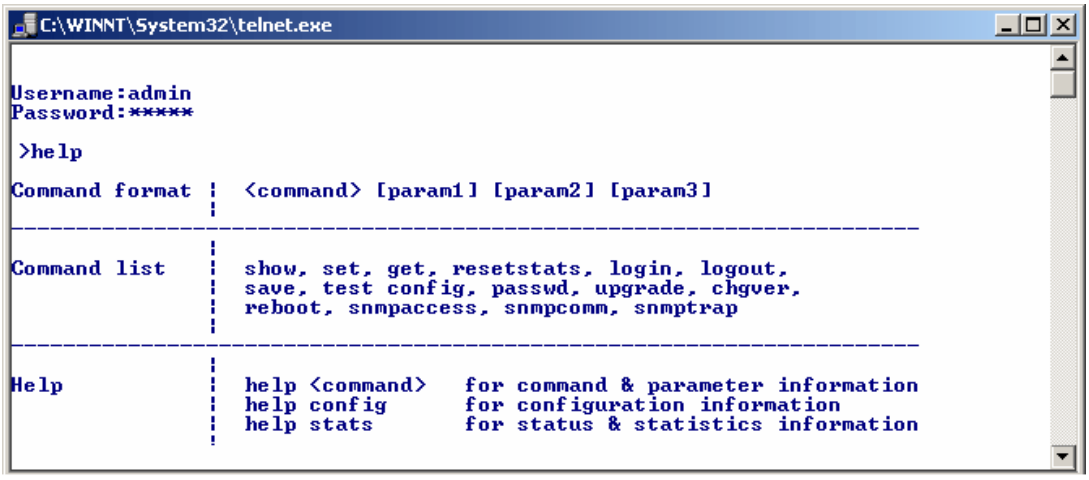
System Configuration and Operation via Telnet

All operator communications with the LB NI-01 indoor unit may be made using Telnet. This offers the advantage of allowing the operator to access and control the LB NI-01 indoor unit remotely from any geographical location, without the need for a web browser. This section describes the procedures for configuring and operating the LB NI-01 indoor unit via Telnet using the command line interface (CLI).

To connect to the indoor unit, Telnet to the IP address of the indoor unit (default address shown below).



When the command prompt screen appears, login using your Username and Password.



The indoor unit may now be configured and queried using a set of CLI commands that mirror the parameters available via the Web Interface. Type 'help' for a list of general commands. For a complete list of CLI commands common to Telnet and Console, see Appendix C.

System Configuration and Operation via SNMP

The LB NI-01 will work with any third party network management system supporting SNMP v1 and MIB II. Most of the statistics and configuration parameters available through the web interface are supported via SNMP. The latest LB NI-01 MIB file may be obtained by contacting your Alvarion certified partner or system integrator, or by downloading it from the 'Support' area of our website.

Network Management Overview

SNMP (Simple Network Management Protocol) is a distributed network management system designed to monitor network infrastructure and application availability. SNMP has become the de facto standard for inter-network management.

Network management systems consist of two primary elements: managers and agents. The manager is the console through which the network administrator performs network management functions. Agents are the entities that interface to the actual devices being managed.

The LB NI-01 is an example of a 'managed device'. Managed devices contain managed objects that may be hardware, configuration parameters, performance statistics, etc. that directly relate to the operation of the device in question, and are contained in a virtual information database

known as a Management Information Base, or 'MIB'. SNMP allows managers and agents to communicate for the purpose of accessing these objects.

Management information bases (MIBs) are a collection of definitions which define the properties of the managed object within the device to be managed. Every managed device keeps a database of values for each of the definitions written in the MIB. The MIB is not the actual database itself - it is implementation dependant. The latest Internet MIB is given in RFC 1213, sometimes known as MIB-II.

System Configuration and Operation via Console Port

All operator communications with the LB NI-01 indoor unit may be made using a direct connection to the serial Console Port on the back of the indoor unit. This section describes the procedures for configuring and operating the LB NI-01 indoor unit via the Console Port using the command line interface (CLI).

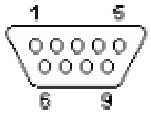
Connect a PC/Terminal to the LB NI-01 indoor unit's serial port DB9 connector using a cross-connect or null modem cable (DB9 female-female). Set the PC/Terminal to emulate a VT-52 or VT-100 terminal.

Use the following port settings:

- Bits Per Second: 9600
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: Hardware

Hit the 'Enter' key – the LB NI-01 prompt will appear.

The diagram on next page shows the 9 PIN D-SUB male connector pin-out at the LB NI-01 Indoor unit:



Pin	Name	RS232	V.24	Description
1	CD	CF	109	Carrier Detect
2	RXD	BB	104	Receive Data
3	TXD	BA	103	Transmit Data
4	DTR	CD	108.2	Data Terminal Ready
5	GND	AB	102	System Ground
6	DSR	CC	107	Data Set Ready
7	RTS	CA	105	Request to Send
8	CTS	CB	106	Clear to Send
9	RI	CE	125	Ring Indicator

Note: RS232 column is RS232 circuit name.

Note: V.24 column is ITU-TSS V.24 circuit name.

The indoor unit may now be configured and queried using a set of CLI commands that mirror the parameters available via the Web Interface. Type 'help' for a list of general command. For a complete list of CLI commands common to Telnet and Console, see Appendix C.

Configuration

The System Configuration page provides a simple to use Graphical User Interface (GUI) for the operator to input a complete set of system parameters for both the Ethernet and Wireless components of the BreezeACCESS LB unit. To store the parameters into memory, click the Save Configuration button at the bottom of this page. This operation is recorded in the Log File.

Note: It is important to ensure that all fields on the System Configuration page are filled out properly for local and remote BreezeACCESS LB units. Errors in these fields will result in the inability to establish a communication link. Please read this section carefully to ensure a quick, trouble-free deployment.

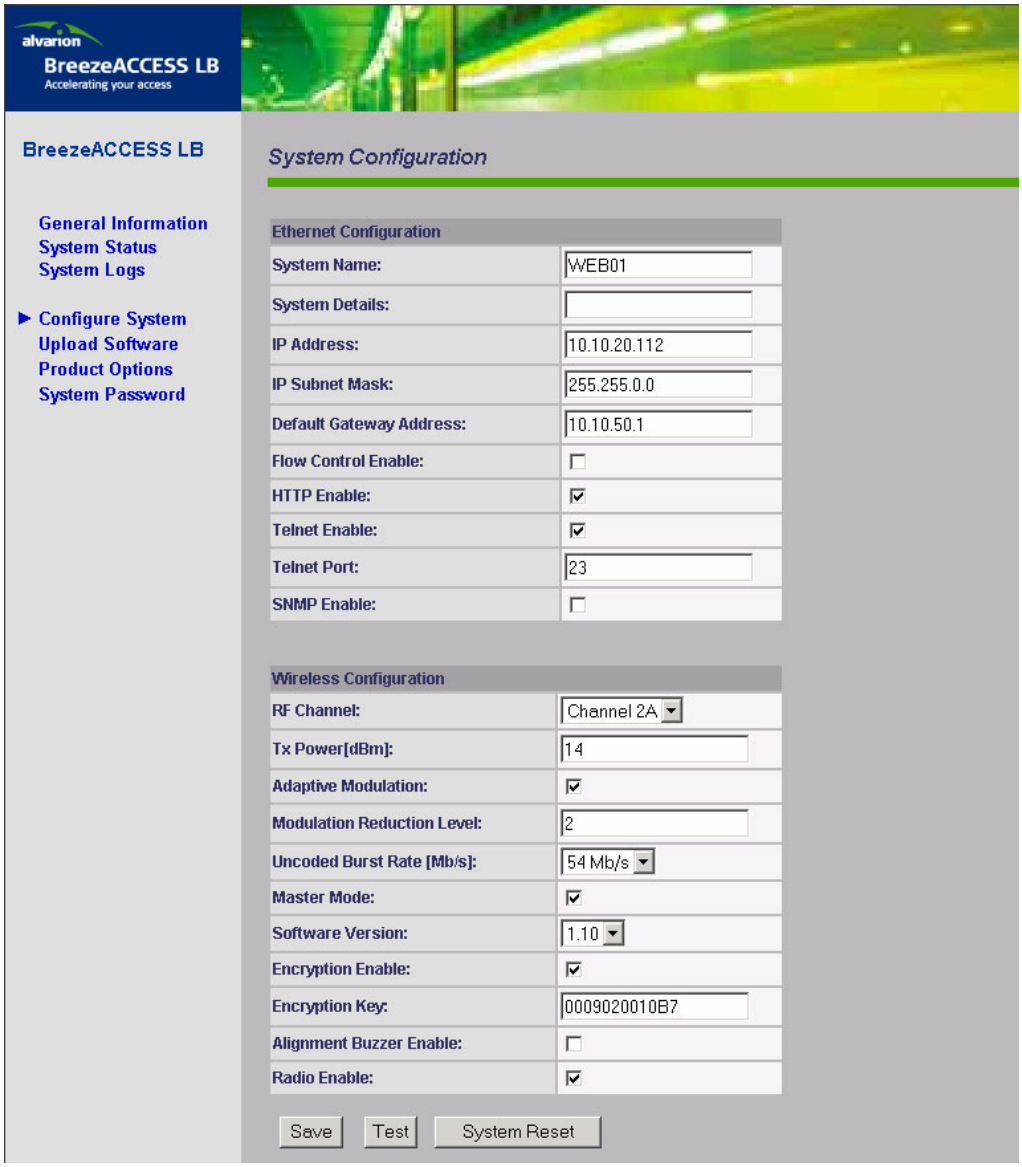


Figure 17: System Configuration

Ethernet Configuration

System Name: The device name is an alphanumeric identifier for the LB NI-01 Indoor unit, which can consist of any combination of letters and numbers up to 20 characters in length. The default name for the BreezeACCESS LB system from the factory is set to WEB01. The device name remains with the system, even during power off state.

System Details: Specifies the location of the unit, telephone number and/or contact information of the network administrator. It can be up to 20 characters in length.

IP address: This field is used to provide an IP address for the LB NI-01 Indoor unit. The default address from the factory is 192.168.25.2. For the initial setup, the LB NI-01 Indoor unit should not be connected to the Internet, i.e., the host computer should be connected directly to the LB NI-01 Indoor unit Ethernet port, to avoid address conflicts with other devices on a public network. Once an IP address has been set, the LB NI-01 Indoor unit can be connected to the core network.

Subnet Mask: This field is used to set the desired IP subnet mask. The mask value is set to "*255.255.255.000*" (Class C subnet).

Default Gateway: Specifies the IP address of the default router / gateway on the local Ethernet segment.

Flow Control Enable: Flow control is a feature that Ethernet devices use to pause transmission of incoming packets. If a buffer on the Ethernet port is overrun, the port transmits a special packet (pause frame) that requests remote ports to delay sending packets for a period of time.

HTTP Server Enable: Specifies whether configuration can be done using the HTTP interface.

Telnet Enable: Telnet is used to connect to remote devices, usually via Telnet port 23. Once a Telnet connection is established, it is possible to log in using the 'admin' or 'user' user id and set the parameters of the unit using the CLI.

Telnet Port: The default Telnet port is 23. The port can be changed to any other number between 23 and 65,000, excluding port 80.

SNMP Enable: Specifies whether the Simple Network Management Protocol (SNMP) agent is enabled. When this item is checked, clicking on [Configure SNMP] beside the checkbox displays a listing of the current SNMP communities and associated parameters.

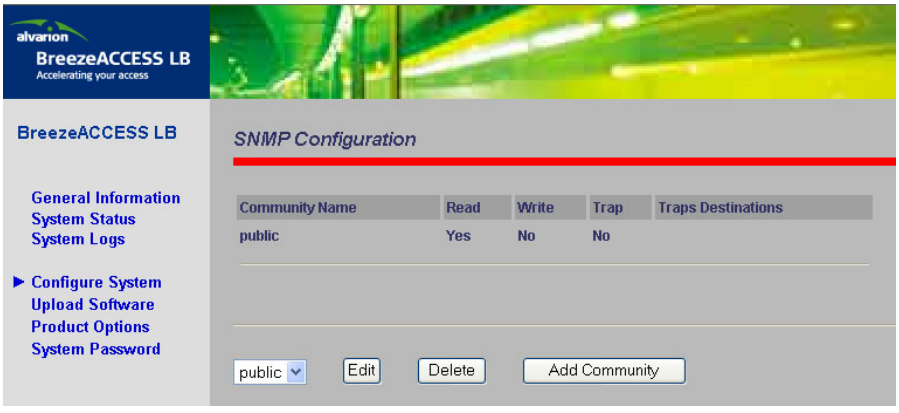


Figure 18: SNMP Configuration

SNMP Configuration: The list of currently defined communities is displayed in the Community table. To add a new community, click 'Add Community'. The Community configuration screen will appear as shown below.

To edit an existing community, select the community from the pull down menu and click 'Edit'. The Community Configuration screen will appear as shown below.

To delete an existing community, select the community from the pull down menu and click 'Delete'. It is not possible to delete the "public" SNMP community. However, its access level can be changed.

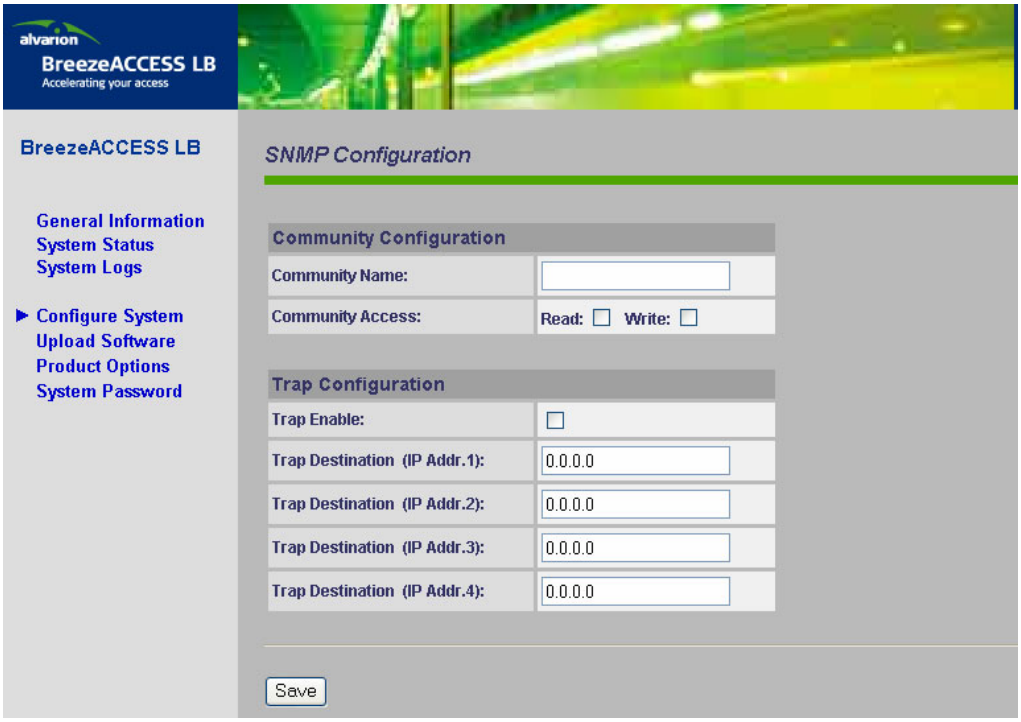


Figure 19: SNMP Community Configuration

Community Configuration

Community Name: Enter the SNMP community name in this field.

Community Access - Read: Check 'Read' to grant read access permission to members of this community

Community Access - Write: Check 'Write' to grant write access permission to members of this community

Community Access - No Access: Uncheck 'Read' and 'Write' options if you wish to prevent members of this community from receiving responses to their SNMP requests.

Trap Configuration

Trap Enable: When the SNMP Agent in the BreezeACCESS LB detects an error condition, a message known as a trap is sent. A Trap Host is an IP workstation/server that is set up to receive SNMP trap messages. Checking this option enables trapping.

Trap Destination (IP Addresses [n]): Enter the IP addresses of the Trap Host in dotted decimal format. The maximum number of destinations is four.

Wireless Configuration

RF Channel: specifies the operating channel of the system, within the 100 MHz available in the 5.8 GHz UNII band. The table below specifies the center frequencies of each permitted channel.

Channel	Frequency
1	5735 MHz
1A	5745 MHz
2	5755 MHz
2A	5765 MHz
3	5775 MHz
3A	5785 MHz
4	5895 MHz
4A	5805 MHz
5	5815 MHz

To avoid interference, two PTP links operating in the same physical location (co-located) or within close proximity must be separated by at least one channel, i.e., the gap between channels must be 20 MHz or more (e.g., channels 2 and 3). Refer to Section 6-11 for further information regarding deployment conventions.

Max Tx Power: this parameter specifies the maximum power level of the system. Depending on the RF channel and FCC regulations, the software will determine the actual power to be used, which will not exceed this user defined value. Refer to Table 1 below. The Actual Tx Power is displayed on the System Status page.

The Actual Tx Power is set by the software / firmware to the maximum power permitted for each channel according to the modulation scheme, as shown in the following table:

Table 1: Max. Operational Power Per Channel (dBm) vs. Modulation

Tx Channel	64QAM ¾ 54 Mb/s	64QAM 2/3 48 Mb/s	16QAM ¾ 36 Mb/s	16QAM 1/2 24 Mb/s	QPSK ¾ 18 Mb/s	QPSK ½ 12 Mb/s	BPSK ¾ 9 Mb/s	BPSK ½ 6 Mb/s
1	-5	-5	-5	-5	-5	-5	-5	-5
1A	14	14	14	14	14	14	14	14
2	14	15	15	15	15	15	15	15
2A	14	15	19	20	20	20	20	20
3	14	15	19	20	20	20	20	20
3A	14	15	19	20	20	20	20	20
4	14	15	15	15	15	15	15	15
4A	14	14	14	14	14	14	14	14
5	-5	-5	-5	-5	-5	-5	-5	-5

Adaptive Modulation: checking this box sets the system to operate in adaptive modulation mode. It is recommended to keep the BreezeACCESS LB in this mode so that the system can automatically change the modulation scheme to the highest possible order, based on measured RF performance. The user can define the desired modulation scheme by setting the Modulated Burst Rate parameter (see next item). If the Actual Modulated Burst Rate meets or exceeds this data rate, the Wireless Signal LED on the front panel lights solid green. If packet errors exceed one in one million, the system will automatically step down the modulation scheme to maintain the link. The Wireless Signal LED will flash green if the Actual Modulated Burst Rate is lower than the configured Modulated Burst Rate. If errors continue when the system reaches the lowest order modulation scheme, the Signal and Link LEDs will turn off to indicate a failed RF link.

The user can also disable the dynamic modulation mode by un-checking the Adaptive Modulation checkbox. In this manual mode, the user is required to set the Modulated Burst Rate and the Modulation Reduction Level (see below). It is recommended not to operate the system in manual mode. If it is necessary to operate in manual mode, first sample the link with Adaptive Modulation enabled, then switch to manual mode and use a lower order modulation scheme.

Uncoded Burst Rate [Mb/s]: Defines the desired modulated data rate for the link. Obtaining a 64 QAM license key (see section 4.13) raises the available Modulated Burst Rate from the default 36 Mbps to 54 Mbps.

Modulation Reduction Level: applies when Adaptive Modulation is disabled. Specifies how many levels the system must drop in modulation during re-transmission of erroneous wireless packets. The level can be set from 0-7, with 2 being the recommended value.

Master Mode: Sets one of the BreezeACCESS LB units to serve as the master system, while the other BreezeACCESS LB unit assumes a slave role. There are no consequences related to setting either unit to serve as the master or slave for this version release.

Software Version: Specifies the current version of the system software. Note that the software can be remotely downloaded into the BreezeACCESS LB unit. The system includes sufficient memory to hold two independent software loads. The operator can specify which software load is used in the system.

Encryption Enable: Specifies whether the over-the-air encryption is enabled. Note if encryption is enabled, it must be enabled on both the local and remote units. Otherwise, no Ethernet traffic can be transferred.

Encryption Key: Enter the MAC address of the remote LB NI-01 Indoor unit to enable over-the-air data encryption. Note, if the MAC address is not properly entered, no Ethernet packets can be transferred.

Alignment Buzzer Enable: Enables the antenna alignment tone sweep generator located in the LB RE-01 Outdoor unit for fine tuning using actual signal strength. Faster repetitions of the tone sweep indicate better alignment.

Radio Enable: Specifies whether radio transmission is enabled.

Save: Saves the currently entered parameters. Note that clicking Save Configuration will also initiate a "short reset" - a useful feature when a reset is required on a remote LB NI-01 Indoor unit.

Test: Allows testing of the current settings for five minutes, after which the system reverts to the previously saved settings. To make settings permanent, click on “Save”.

System Reset: Resets all statistics and reboots the indoor unit.

General Information

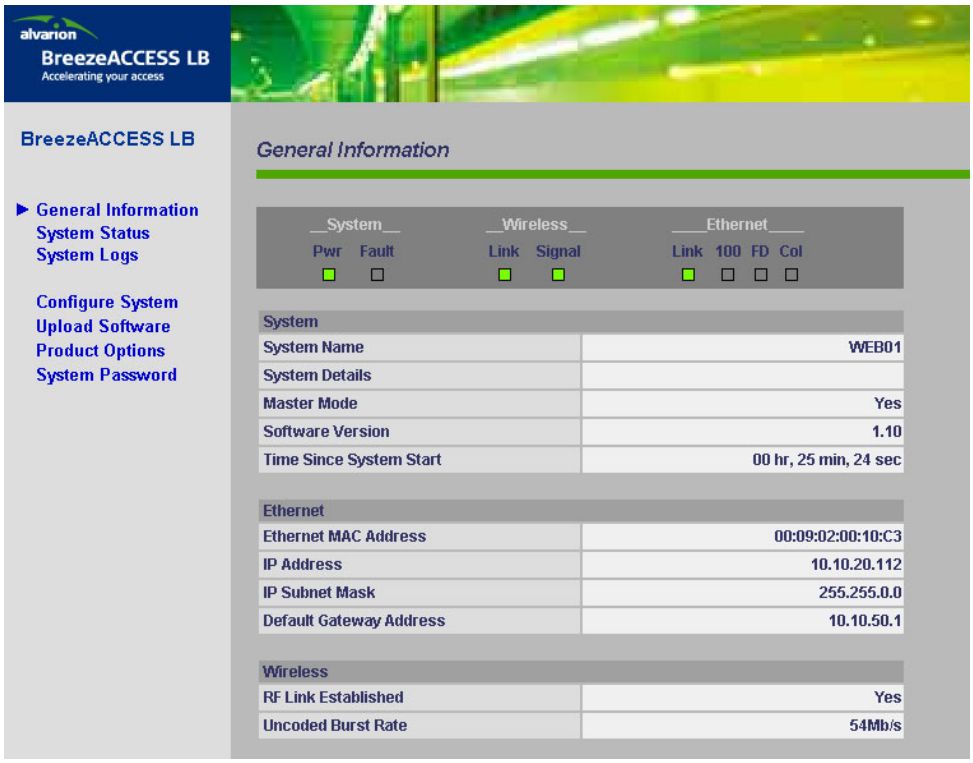


Figure 20: BreezeACCESS LB General Information

Located at the top of this page is a graphic interface providing a real-time view of the BreezeACCESS LB unit front panel (refreshed every 30 sec.), plus a summary of general information related to the configuration and status of the local unit.

The following is a brief description of each field on the General Information page:

System Name: Identifies the local LB NI-01 Indoor unit. The default name for the BreezeACCESS LB system from the factory is “WEB01”.

System Details: Specifies the location, phone number and/or contact information.

Uncoded Burst Rate: Indicates the current modulation burst rate of the system. With adaptive modulation, this data rate may change over time, depending on the prevailing propagation conditions.

Master Mode: Indicates if the system is serving as the master or slave.

Software Version: Specifies the software version in use.

Time since System Start: Specifies the time [dd/hh/mm/ss] since the system was last started.

Ethernet MAC Address: Specifies the Ethernet MAC address used by the local LB NI-01 Indoor unit.

IP Address: Specifies the IP address used by the local LB NI-01 Indoor unit.

Subnet Mask: Specifies the IP Subnet Mask used by the local LB NI-01 Indoor unit.

Default Gateway: Specifies the IP address of the default router / gateway on the local Ethernet segment.

RF Link Established: "Yes" indicates the RF link with the remote LB NI-01 Indoor unit is established. "No" indicates there is no RF link to the remote LB NI-01 Indoor unit. This indicator is correlated to the Wireless Link LED.

Uncoded Burst Rate [Mb/s]: The actual current Uncoded Burst rate for the link. Obtaining a 64 QAM license key (see section 4.13) raises the available Modulated Burst Rate from the default 36 Mbps to 54 Mbps.

System Status

Clicking on System Status in the main menu will load this page, which provides General Information, Ethernet LAN Statistics and Wireless Statistics, as shown in Figure 21.

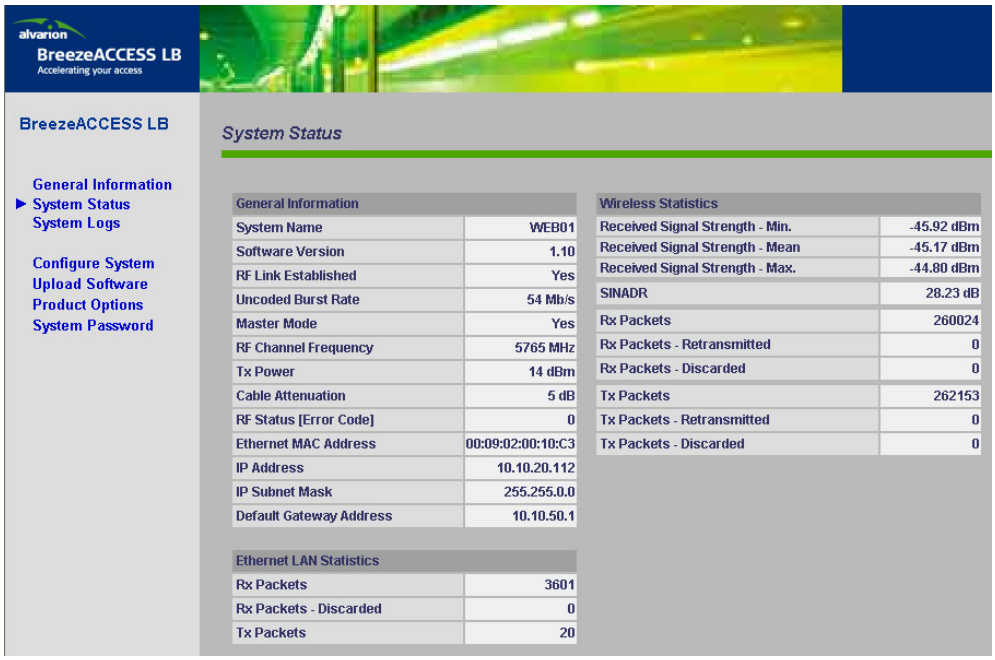


Figure 21: System Status

General Information: Identical to the information found on the General Information page, with the addition of:

RF Channel Frequency: Specifies the center frequency of the channel in use.

Tx Power: Specifies the actual current transmit power level.

Cable Attenuation: Indicates the attenuation of the signal over the IF cable.

RF Status: An error code from 0-31 indicating the condition of the RF components within the LB NI-01 Indoor unit and LB RE-01 Outdoor unit. See the RF Status Error Code table below for details.

Table 2: RF Status Error Codes

Error Code	LB NI-01 Indoor unit PLL Error	Communication Error Over IF Cable	LB RE-01 High Temp. Warning	LB RE-01 Power Supply Fault	Low DC Voltage At LB RE-01 Input
0 - NO ERRORS					
1					X
2				X	
3				X	X
4			X		
5			X		X
6			X	X	
7			X	X	X
8		X			
9		X			X
10		X		X	
11		X		X	X
12		X	X		
13		X	X		X
14		X	X	X	
15		X	X	X	X
16	X				
17	X				X
18	X			X	
19	X			X	X
20	X		X		
21	X		X		X
22	X		X	X	
23	X		X	X	X
24	X	X			
25	X	X			X
26	X	X		X	
27	X	X		X	X
28	X	X	X		
29	X	X	X		X
30	X	X	X	X	
31	X	X	X	X	X

Error Details:

LB NI-01 PLL Error: The PLL (Phase Locked Loop) section within the LB NI-01 Indoor unit experienced an error. The System Fault LED may light. Action: Try resetting the unit.

Communication Error Over IF Cable: Communication between the LB NI-01 Indoor unit and the LB RE-01 Outdoor unit failed. Action: Check the IF cable and connectors.

Radio High Temp. Warning: The LB RE-01 Outdoor unit's internal temperature rose above 185F / 85C. Action: The LB RE-01 will shut down for 30 seconds to allow cooling time.

Radio Power Supply Fault: Indicates a fault in the LB RE-01's power supply. This error could be due to a problem with the internal power supply, or with the power source from the LB NI-01 Indoor unit. Action: If the Low DC Voltage At radio error is also indicated, (see below) check the IF cable and connectors. If the Low DC Voltage at radio error is *not* indicated, the LB RE-01 Outdoor unit will require servicing.

Low DC Voltage At radio Input: The DC voltage at the LB RE-01 outdoor unit (carried by the IF cable from the LB NI-01 Indoor unit) is lower than the required 24VDC. Action: Check the IF cable and connectors.

Ethernet LAN Statistics

Rx packets: Counts the number of packets successfully received by the local system.

Rx packets - Discarded: Counts the number of packet errors received by the local system.

Tx Packets: Counts the number of Ethernet packets transmitted by the local system.

Wireless Statistics

Received Signal Strength – Min: Indicates the minimum received signal strength measured since the last screen refresh.

Received Signal Strength – Mean: Indicates the average received signal strength, computed since the last screen refresh.

Received Signal Strength – Max: Indicates the maximum received signal strength measured since the last screen refresh.

SINADR: Indicates the average signal to interference, noise and distortion ratio measured since the last screen refresh. The ratio is based on the digital information provided from the output of the A/D converter, and includes the effects of the AGC.

Rx Packets: Indicates the number of wireless packets received over the air from the remote LB NI-01.

Rx packets - Retransmitted: Indicates the number of wireless packets retransmitted over the air from the remote LB NI-01.

Rx Packets - Discarded: Indicates the number of wireless packets originating from the remote LB NI-01 received over the air with errors due to degradation in the RF link.

Tx Packets: Indicates the number of wireless packets (including Ethernet frames and error correction bytes) successfully transmitted over the air by the local LB NI-01.

Tx packets - Retransmitted: Indicates the number of wireless packets retransmitted over the air by the local LB NI-01. The retransmission scheme is based on the Automatic Repeat Request (ARQ) algorithm that detects when packets are lost, and makes a request to the MAC scheduler to repeat transmission of the lost packets.

Tx Packets - Discarded: Indicates the total number of transmitted wireless packets discarded by the remote LB NI-01, due to degradation in the RF link.

Reset Statistics: Click this button to clear the data for the Wireless and Ethernet LAN Statistics on this page. You will be prompted for your password.

Upload Software

The upload screen as shown on next page is used to upgrade the existing software load of the LB NI-01 indoor unit with new software stored in a binary file on the server or host computer. Note the LB NI-01 indoor unit contains two memory pages for storing two versions of the software/firmware. The user can select the operating version using the Configuration screen Software Version. The upload will always overwrite the secondary (unselected) version; therefore it is important to select the desired operating version before beginning the upgrade process.

The upgrade process can be achieved remotely, using the Trivial File Transfer Protocol (TFTP) over the Internet. Two input fields must be filled in by the operator: TFTP Server IP Address and File Name. The TFTP Server IP Address is the IP address of the host computer or server that contains the upgrade software in binary format, while File Name is the name of the actual binary file.

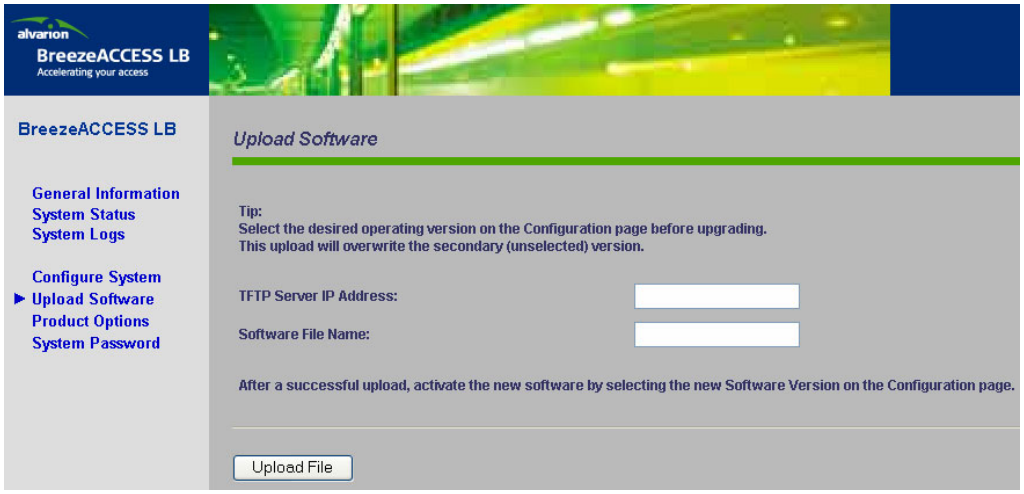


Figure 22: Software Upgrade

After typing the TFTP Server IP Address and File Name, click Upload File to begin the file transfer. A status screen (see Figure 23) will appear, displaying the number of bytes being transferred from the host computer/server to the LB NI-01 Indoor unit in real time. The upgrade file size is approximately 1.5 MB, and will take approximately two to four minutes to download from the server to the LB NI-01 Indoor unit memory. To activate the new version, it is necessary to go to the Configuration page and select the new Software Version.

Upon successful transfer of the upgrade file, the LB NI-01 Indoor unit will verify the integrity of the new software. If errors were introduced during the transfer process as a result of (for example) link degradation, the LB NI-01 Indoor unit will reject the new software load and provide a warning that the upgrade was unsuccessful. In this case, the operator will need to repeat the upgrade process.

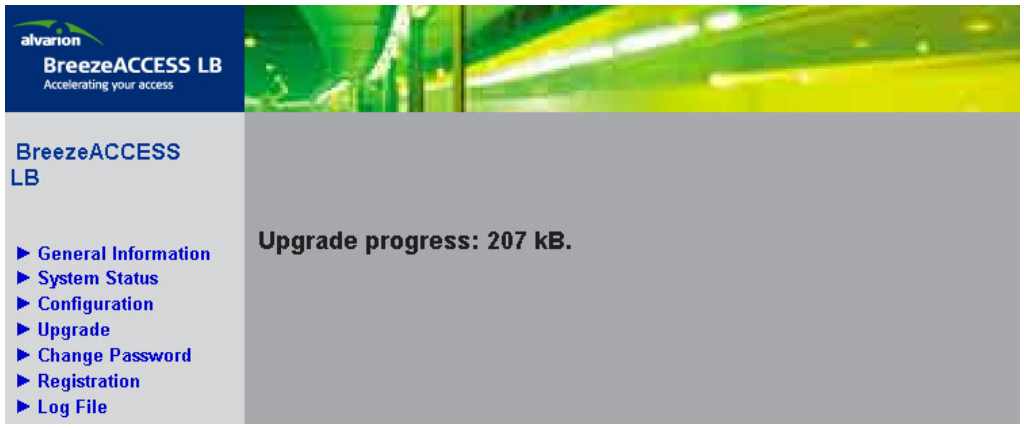


Figure 23: Status of The Upgrade File Transfer

System Password

The factory default password for the system is "admin" for the administrator's ID and "user" for the User's ID. To change the password, click on System Password from the main menu and apply a new value in the New Password field (see Figure 24) using any alphanumeric combination. Note the field is ***case sensitive*** and can be up to 16 characters in length.

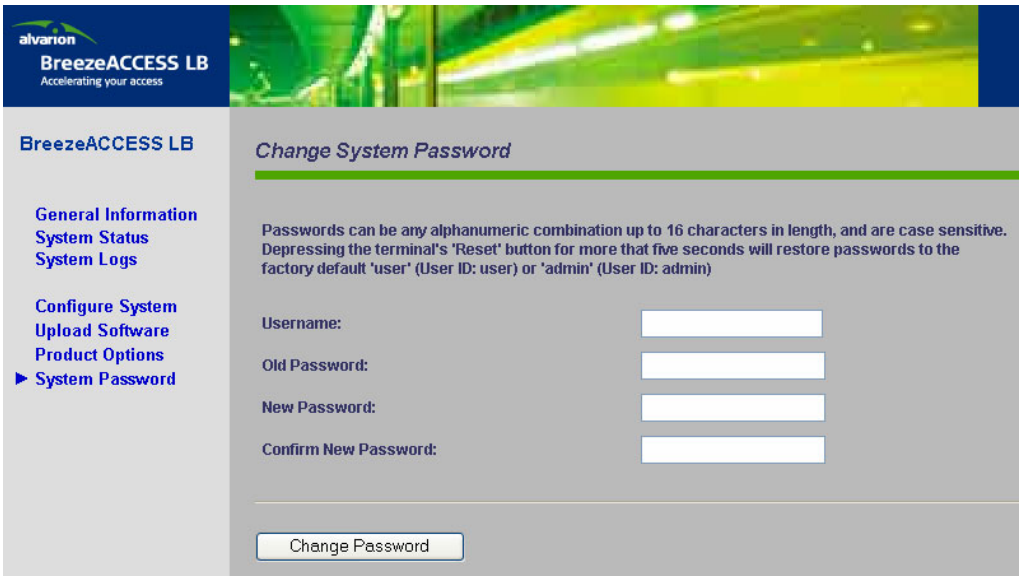


Figure 24: System Password

Product Options

The 72 Mbps rate License Key (an optional purchase item) raises the available Modulated Burst Rate from the default 36 Mbps to 54 Mbps.

The product options License Key is personalized to each unit's MAC address. Please ensure that the correct MAC address is provided when requesting a key from your local Alvarion representative, or contact our Technical Support department at usa-support@alvarion.com

Enter the key **(Case Sensitive)**, ensure it is correct, and click "Send Key".

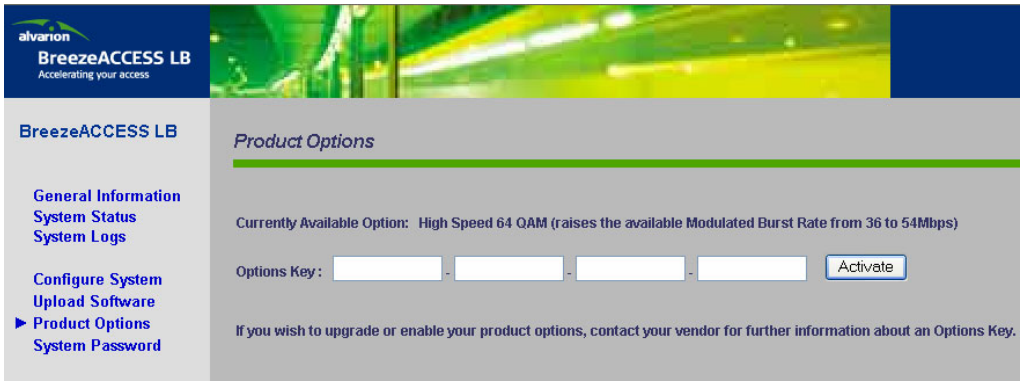


Figure 25: Options Key

System Logs

The System Logs page, shown in Figure 26 below, provides a list of the last forty messages recorded by the LB NI-01 Indoor unit, describing either system activity or errors that have occurred.

Figure 26: System Log Screen

The logs will also indicate if the following transactions were successfully completed:

- **Save Configuration –** Under the Configuration screen.
- **Upload –** Under the Upgrade screen.
- **Change Password –** Under the Change Password screen.
- **Send Options Key**

The following table provides a brief description of the key messages recorded in the Log File by the system:

Log Message	Description
100-Parameters loaded successfully!	All system parameters have been successfully downloaded.
101-Firmware configuration OK!	The onboard firmware configuration has been properly set up.
102-Ethernet port configured!	The Ethernet port has been properly configured and is operational.
103-Parameters saved successfully!	The latest configuration parameters have been successfully saved into the system memory.
104-Upgrade OK!	The software upgrade process completed successfully.
105-Password changed successfully!	The system password was successfully changed.
106-Firmware programmed OK!	The firmware was successfully programmed.
107-Statistics initialized!	Reset of statistics was successful.
108-Version control loaded successfully!	Software version control data was successfully loaded.
109-Options Key activated!	Product Options Key was accepted.
110-Options Key already used!	The Product Options Key was not accepted because it was already used once. Contact your local Redline representative.
111-SNMP configuration loaded successfully!	The SNMP configuration was successfully loaded.
201-EEPROM corrupted. Def. param. loaded!	The memory area containing the system configuration has been corrupted. Default parameters loaded.
202-Error while saving parameters!	The latest configuration parameters have not been successfully saved. In this case, repeat the save configuration process to try to resolve the problem.
203-Another upgrade in progress!	The system is already in upgrade mode, in the event the operator inadvertently invoked multiple simultaneous upgrades.
204-Invalid upgrade parameters!	The parameter entered is in error. If this message appears, check for typing errors.
205-Upgrade failed!	The software upgrade process completed unsuccessfully.
206-Password changed unsuccessfully!	The new password entered into the system was not successful. In this case, repeat the process.
207-Timeout on reading data packet!	The system has timeout looking for packets from the host computer or server. Check for obvious problems such as disconnected or faulty cable.
209-TFTP error received!	TFTP Protocol used to download the software to the LB NI-01 indoor unit during the Upgrade process failed. Likely cause is disconnected or faulty cable.

210-Error: TFTP unknown message!	The TFTP client received an unknown message. In this case, repeat the upgrade process.
211-Error: while writing flash!	While writing the new software into LB NI-01 indoor unit flash memory an unexpected error occurred. Try to repeat the process and if the error persist contact technical support
212-Error firmware configuration!	An unexpected error occurred while writing the onboard firmware configuration. Try to repeat the process.
213-Firmware programming failed!	The firmware programming failed.
214-Error while loading version control!	Software version control data was not loaded successfully.
215-Log buffer full!	The log buffer overflowed.
216-Invalid Options Key!	User entered an invalid Product Options key.
217- PLL unlocked!	One or more RF synthesizers unlocked. The unit stopped RF transmissions and attempted to reprogram the synthesizers. If this message repeats or if the RF link is not back on, try to reset the indoor unit. If the problem persists, contact customer support.
218-Outdoor unit over temperature!	The LB RE-01 ODU internal temperature rose above 185F / 85C. The transceiver will shut down for 30 seconds to allow cooling.
219-Excessive DC loss on IF cable!	The DC voltage at the transceiver (carried by the IF cable from the LB NI-01 indoor unit) is lower than the required 24VDC. Check the IF cable and connectors.
220-Outdoor unit power supply fault!	Indicates a fault in the transceiver's power supply. This error could be due to a problem with the internal power supply, or with the power source from the LB NI-01 indoor unit. If the 'Excessive DC loss on IF cable' error is also indicated, check the IF cable and connectors. If not, the LB RE-01 ODU will require servicing.
221-\public\ community can't be deleted!	The default 'Public' SNMP community cannot be deleted.
222-Max.community number already defined!	No more communities may be defined, as the maximum number has been reached
223-Community name already defined!	The name for the SNMP community has already been used. Choose another name.
224-MIB initialization error!	MIB construction process generated an error. Try to reset the indoor unit. If problem persists, contact customer support.
225-Error while loading SNMP configuration!	EEPROM memory was corrupted and the SNMP configuration couldn't be loaded. Default SNMP configuration was loaded.
226-Error while saving SNMP configuration!	SNMP configuration saving process was not successful. Try again. If problem persists, contact customer support.

Chapter 5

Diagnostics and Troubleshooting

About This Chapter

This chapter is comprised of the following sections:

- **Diagnostics**, page 5-2, describes how diagnostics can be performed using the front panel LEDs of the LB NI-01 Indoor unit
- **Troubleshooting**, page 5-6, describes how to use the Web Interface to perform troubleshooting using the host computer/server connected locally or remotely to the LB NI-01 Indoor unit.

Before beginning any troubleshooting via the front panel, it is important to ensure that all fields on the System Configuration page are filled out properly for local and remote LB NI-01 Indoor units, as outlined in Section 6.1. Errors in these fields will result in the inability to establish a communication link. Also ensure that all cables are properly connected as outlined in Section 3.

This section provides basic diagnostic and troubleshooting procedures to help solve problems that may occur with the BreezeACCESS LB system. If, after reading this section, you are unable to get the system operating properly, please contact your local Alvarion representative. Include the model name and serial number of the system (located on the back of the unit) in your communications.

Diagnostics Using the Front Panel

The front panel of the BreezeACCESS LB NI-01 Indoor unit comprises three sets of status LEDs, grouped under the headings System, Wireless and Ethernet, to help with first level diagnoses of problems encountered with the unit.

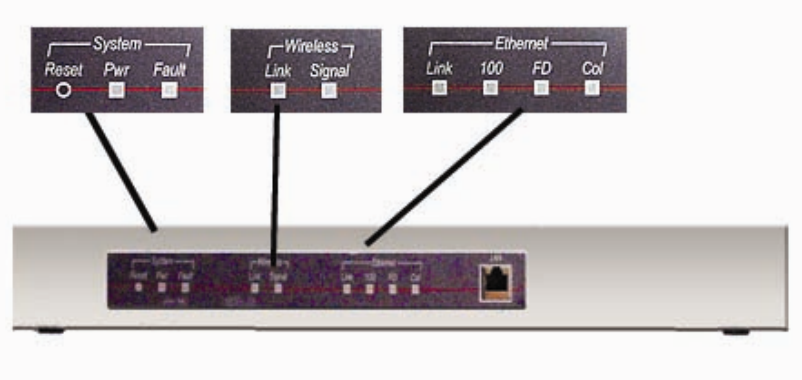
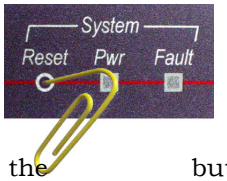


Figure 27: Front Panel Status LEDs



Throughout this section, reference is made to the ***Reset*** button, which is a micro-switch recessed in the front panel in the System block. Use a small narrow object, such as a paper clip, to access the button. Depressing the button for less than five (5) seconds will activate a "short reset", which is equivalent to turning the LB NI-01 Indoor unit off and on. Statistical values are reset, and the currently loaded software / firmware will be retained. Note that a short reset may be accomplished remotely by

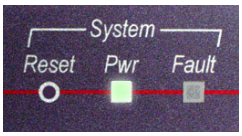
clicking on the Save Configuration button on the System Configuration screen.

Depressing the Reset button for more than five (5) seconds executes a "long reset". **A long reset reloads the factory default configuration settings such as IP Address, Subnet Mask, Channel, Device Name, etc. and restarts the system.** The software version that existed in the system before the long reset is retained. An example of when a long reset will help is in the event that a password or IP address is forgotten. The long reset function will simply restore the system back to its original factory default settings. A long reset is confirmed by the Wireless Link LED flashing three times, followed by the LED power-up sequence:

All four Ethernet LEDs light for one second, then individual Ethernet LEDs blink twice in the following order: 100, FD, Col, Link. The Fault LED lights for approximately four seconds, then turns off. The two Wireless LEDs remain off for approximately five seconds, then resume their normal state.

The remainder of this section lists possible problems that may occur and the corresponding remedies.

System Power

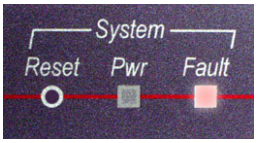


If the **Pwr** LED is not illuminated solid green, power is not getting to the unit. The most probable causes are:

Table 3: System Power Diagnostics

Symptom	Possible Problem	Solution
PWR LED does not illuminate	On/Off switch in Off position	Turn on switch at back of unit.
	Fuse blown	Replace fuse. (spare provided)
	Power cord disconnected	Securely connect cord to LB NI-01 Indoor unit and outlet.

System Fault



If the **Fault** LED illuminates solid red, it is an indication that there is a serious problem with the system software or hardware. Check the IF cable. A short or long reset may fix the problem. If not, contact your local Alvarion representative. Also refer to the RF Status codes in Table 2, as well as the Log file.

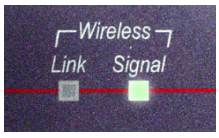
Wireless Link

The Wireless **Link** LED illuminates solid green when the wireless link is established to the remote LB NI-01. When the Link LED is off, it is an indication there is a problem with either the LB NI-01 link, LB RE-01, or with the actual propagation path itself. Check the RF Status parameters in the System Status screen. The table below lists some of the potential causes:

Table 4: Wireless Link Diagnostics

Symptom	Possible Problem	Solution
No wireless link (Link LED does not illuminate)	Remote LB NI-01 Indoor unit is not on or is malfunctioning.	Verify operation of remote LB NI-01 Indoor unit.
	The propagation path is blocked.	Clear path or re-locate antennas.
	The LB RE-01 is mal-functioning.	Repair or replace LB RE-01
	Antenna has moved and is no longer aligned with remote LB NI-01 Indoor unit.	Re-align the antenna.
	Cable between LB RE-01 and antenna or between LB RE-01 and LB NI-01 Indoor unit not properly connected.	Properly secure cables.
	Power not getting to the LB RE-01 from the LB NI-01 Indoor unit.	Repair or replace LB NI-01 Indoor unit.
	Receiver and transmitter have been set to different RF channels.	Make sure both units are operating on the same RF channel.

Wireless Signal



When Adaptive Modulation is enabled, the Wireless **Signal** LED will light solid green if the system is operating at the configured Modulated Burst Rate, and will flash when the system is operating at a lower order modulation scheme (i.e., the Actual Modulated Burst Rate is lower than the configured Modulated Burst Rate). If the system cannot maintain the lowest modulation scheme due to link errors, the Signal LED will turn off.

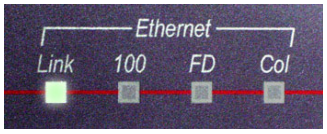
When Adaptive Modulation is disabled, the Wireless Signal LED will light solid green if the system is operating at an error rate of less than one out of one million packets. If errors exceed one in one million, the LED will flash. If the wireless link becomes poor, the LED will turn off.

Flashing may not be a serious problem if the LED flashes only intermittently, however, if it flashes constantly, the table below summarizes some possible causes:

Table 5: Wireless Signal Diagnostics

Symptom	Possible Problem	Solution
Weak RF Link (Signal LED flashes)	Obstructions in the propagation path causing signal degradation.	Try to remove obstacles or re-locate antenna.
	Antenna moved, due to high winds.	Re-align the antenna.
	Poor cable connection between LB RE-01 and antenna.	Repair or replace the RF cable.

Ethernet Link

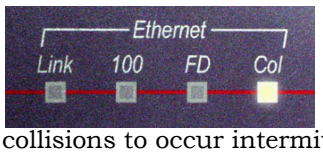


The Ethernet **Link** LED will light solid green when the LAN connection to the host computer/server or switch/router is functioning properly. The Link LED flashes when the LAN connection to the host computer/server or switch/router is functioning properly and there is traffic. If the LED is off, look for the following problems:

Table 6: Ethernet Link Diagnostics

Symptom	Possible Problem	Solution
No Ethernet Link (***Link*** LED off)	Poor cable connection between LB NI-01 Indoor unit and computer/server or between LB NI-01 Indoor unit and switch/router.	Carefully check all cable connections.
	Wrong type of Ethernet cable between LB NI-01 Indoor unit LAN port and host computer/server or switch/router.	If the LB NI-01 Indoor unit LAN port is connected to a host computer or server directly, then ensure a straight-through cable is used. Otherwise, to connect the LB NI-01 Indoor unit to a switch or router, ensure a crossover cable is used.
	The auxiliary Network equipment including switch/router, host computer/server, may be malfunctioning.	Repair or replace faulty units.
	Processor malfunction.	Try short reset or long reset.

Ethernet Collision



The Ethernet **Col** LED flashes amber when packet collisions occur over the LAN. Note that when connected to a hub, it is typical for packet collisions to occur intermittently. However, if the LED flashes constantly, or flashes when the LB NI-01 indoor unit is connected to a switch or router, there is a serious problem with the LAN connection. Some possible causes include:

Table 7: Ethernet Collision Diagnostics

Symptom	Possible Problem	Solution
Link Collision (***Col*** LED flashes)	Poor cable connection between LB NI-01 Indoor unit and computer/server or between LB NI-01 Indoor unit and switch/router.	Carefully check all cable connections.
	Incompatible Ethernet port speed.	Confirm speed and duplex mode of devices.

Troubleshooting using The Web Interface

This section assumes that the status LEDs on the front panel of the LB NI-01 Indoor unit indicates normal functionality.

If, after using HTTP commands to try to log onto the LB NI-01 Indoor unit the General Information page does not appear on-screen, several possibilities exist. The first test is to ping the LB NI-01 Indoor unit from the host computer by entering the following text from the command line:

>Ping 192.168.25.2

Note the IP address used in this example is the default address supplied by the factory. If the IP address has been changed, it is important to use the current address.

If the ping test is successful (i.e., the computer was able to send and receive packets to/from the LB NI-01 Indoor unit) then the problem may be with the IP address that was entered or with the HTTP server itself. Retype the address or re-boot the host computer to try to resolve the problem.

If the ping is unsuccessful, there may be problems with the IP address that you are using. Try retyping the address. If this fails, and it appears you have forgotten the IP address of the LB NI-01 Indoor unit, perform a long reset to restore the LB NI-01 Indoor unit to the default value.

Warning: performing a long reset will restore the BreezeACCESS LB NI-01 Indoor unit's IP address (192.168.25.2) and Subnet Mask (255.255.255.0) to the factory default value

Table 8: Web Interface Diagnostics

Symptom	Possible Problem	Solution
Home page (General Information) cannot be accessed.	Incorrect IP address and/or Subnet Mask.	Perform a ping test from the host computer command line. If the ping test is unsuccessful, then the problem is with the IP address. Perform a long reset to apply the default address (192.168.25.2) and Subnet Mask (255.255.255.0)
	Problems with host computer, or LB NI-01 Indoor unit.	If the ping is successful try a short reset of the LB NI-01, and/or reboot the host computer.
	Host PC ARP table is incorrectly configured	Run "arp –d" whenever the LB NI-01 Indoor unit is swapped. Check that the host PC's subnet Mask matches that of the LB NI-01 Indoor unit. Check that the host PC's address is 192.168.25.n, where 'n' is not equal to 0, 2, or 255.

Chapter 6

Wireless Broadband

About This Chapter

This section provides an overview of the design and benefits of a Wireless Broadband network architecture based on the Alvarion BreezeACCESS LB system.

There are several advantages of a Wireless Broadband system over traditional wire line alternatives such as PSTN, ISDN, T1, DSL, cable and fiber, including:

- Greater availability
- Lower cost of ownership per link
- Higher throughput (with the exception of fiber)
- Greater distances
- Quicker time to market
- Greater portability

The BreezeACCESS LB system functions logically as a transparent bridge, providing all the benefits of a converged IP network, i.e., "IP everywhere". A converged network allows operators to reduce network build-out costs significantly by employing standard IP appliances everywhere, from backbone to end-user.

Who Can Benefit From The BreezeACCESS LB System?

The BreezeACCESS LB system is an ideal solution for:

- Carriers
- Internet Service Providers (ISPs)
- Enterprises
- Educational Institutions and Campuses

Carriers

The BreezeACCESS LB system will provide benefits to both Incumbent and Competitive Local Exchange Carriers (ILECs and CLECs, respectively). Although ILECs own and provide services over wireline infrastructures within a specific geographical area, they are faced with the challenges of reaching outlying regions suffering from poor to no service. The ILEC is usually compelled to provide an expensive solution using a series of PTP radio links, with low throughput (e.g., T1) and costly license fees and network interfaces including T1 multiplexers. The BreezeACCESS LB system provides a cost-effective alternative, by connecting a remote site from the local CO, as shown in see Figure 28.

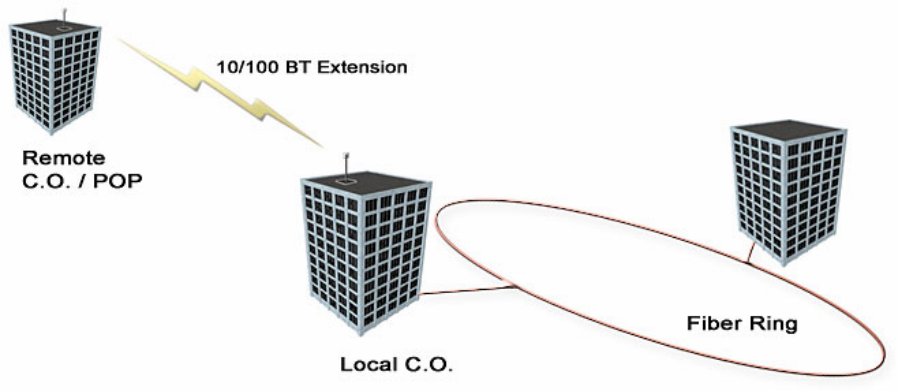


Figure 28: Wireless Extension for Carriers

The same challenges are faced by CLECs, who can use the BreezeACCESS LB system to:

- Extend their existing fiber network, and
- Establish a remote Point of Presence (POP).

Internet Service Providers

The BreezeACCESS LB system is perfect for ISPs looking to provide cost-effective broadband solutions to demanding business customers including Small Office Home Office (SOHO) and Small to Medium sized Enterprises (SME) located just outside of the downtown core, where there is a lack of infrastructure. High-speed leased lines are expensive and hard to obtain, especially from local telephone companies. Wireless access provides a reliable quality of service over longer distances, while avoiding Telco access fees.

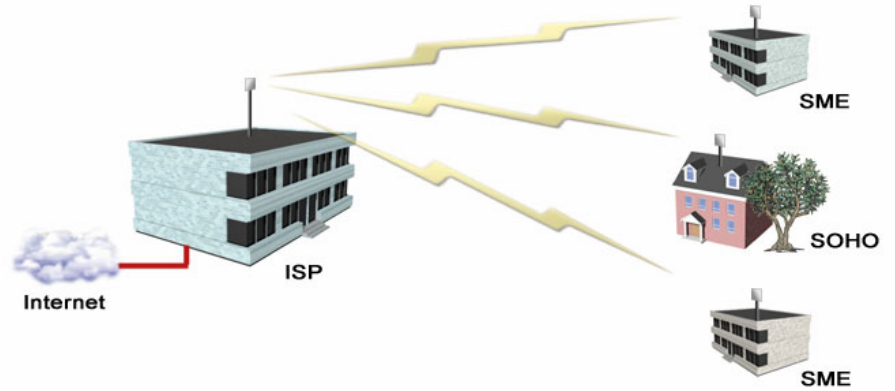


Figure 29: Wireless Solution For ISPs

Enterprises

Enterprises are particularly frustrated by the lack of broadband connectivity to branch offices, factories, or warehouses located just outside of the urban core. Establishing a LAN solution over several remote locations presents a significant inter-network challenge using conventional wire line solutions. The BreezeACCESS LB system is well suited for addressing LAN extension requirements, offering superior data rates in a secure format using encryption to protect sensitive information.

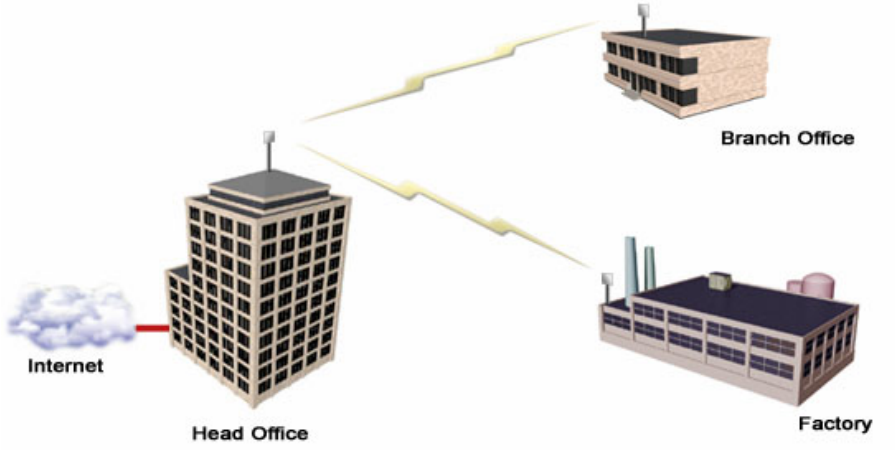


Figure 30: Wireless Solution For Enterprise

Educational Institutions and Campuses

The World Wide Web is a key element within the education system today, with BFW systems serving as an important enabler in bringing Internet content to the student body. Fixed wireless systems such as the BreezeACCESS LB provide a cost effective means of creating a backbone for connecting existing and new campus buildings to the educational infrastructure to support distance learning and two-way interactive training

The BreezeACCESS LB Advantage

The Alvarion BreezeACCESS LB system includes several key features to mitigate the effects of interference arising from other systems operating co-channel in the vicinity, as well as coping with propagation anomalies such as multipath. These features include:

Adaptive Modulation

The BreezeACCESS LB NI-01 Indoor unit automatically selects a modulation scheme in both up and downstream directions to maximize spectral efficiency based on the measured signal to noise and distortion (SINADR) level. The modulation schemes supported are:

- Binary Phase Shift Keying (BPSK)
- Quadrature Phase Shift Keying (QPSK)
- 16 Quadrature Amplitude Modulation (QAM)
- 64 Quadrature Amplitude Modulation (QAM)

Refer to Table 9 for a summary of data rates for each modulation scheme.

Advanced Error Correction

In addition to conventional forward error correction techniques, the BreezeACCESS LB NI-01 Indoor unit uses an Automatic Repeat Request (ARQ) scheme to dramatically reduce errors from interference and multipath

Orthogonal Frequency Division Multiplex (OFDM) Processing

The Alvarion OFDM technique offers tremendous robustness in the presence of harsh multipath interference.

Narrow Beam Width

Narrow antenna beams reduce considerably the probability of interference entering the system.

In addition to the anti-interference features described above, the BreezeACCESS LB NI-01 Indoor unit also holds several other competitive advantages:

- High Data Rates
- High Bandwidth Efficiency

- Long Reach and Wide Coverage
- Higher Power Efficiency
- "Over-the-Air" Security

Wireless Facts

Wireless technology has existed for many years, proving it to be a reliable communication medium, primarily for long haul point-to-point applications supporting critical links across the country for telephony and broadcast services. With the surge of broadband two-way internet use, fixed wireless systems are playing an even more important role in supporting network infrastructures.

The BreezeACCESS LB NI-01 Indoor unit has been designed to operate in the UNII band, which occupies the license exempt portion of the spectrum. This allows an operator to set up a wireless network without requiring formal consent from the regulatory agent. While this provides great advantages in terms of cost and time to market, the ease of access to the spectrum can bring with it undesirable effects, such as potential interference arising from other users exploiting the "free" band. By following the simple deployment guidelines in this manual, issues of this nature can be avoided.

This section provides additional background material to section 5 of this manual, including a description of the Link Budget tool, Fresnel zone considerations, height calculations and radar horizon issues, interference issues with other systems, etc.

The Link Budget Tool

Alvarion has available a Link Budget Tool to help characterize the range performance of the BreezeACCESS LB NI-01 Indoor unit for LOS (line of sight), OLOS (optical line of sight) and NLOS conditions, including various system parameters. The Link Budget Tool can be obtained by contacting your Alvarion certified partner or system integrator. Note the tool provides a first-order approximation, and does not consider the details of any specific terrain profile which may impact performance; rather, a generalized terrain is used in the calculations, based on empirical formulas approved by governing bodies such as the IEEE and ITU. Also, the tool does not consider system parameter variations arising from temperature fluctuations, cable loss tolerance, antenna alignment errors, etc.

The Link Budget Tool estimates the distance over which the system can operate at a desired error rate while achieving robust communication. A link is considered robust if the average error rate is less than 10E-9, for an availability of 99.99%. Availability is described in more detail below.

The table below describes the net data rate (after coding overhead) that can be obtained for each modulation type in an ideal propagation situation.

Table 9: Modulation Scheme vs. Data Rate

Modulation	Coding Rate	Over The Air Rate (Mbps)	Modulated Burst Rate (Mbps)
BPSK	½	12	6
BPSK	¾	12	9
QPSK	½	24	12
QPSK	¾	24	18
16 QAM	½	48	24
16 QAM	¾	48	36
64 QAM	⅔	72	48
64 QAM	¾	72	54

Higher order modulation schemes require greater S/N to maintain the same BER performance. The noise in this case is defined as the noise floor of the receiver, i.e., it assumes no interference from other sources (interference from other sources are addressed below). The main path calculation for determining range performance is given as:

RSL = Ptx + Gtx – FSL + Grx

Where:

Ptx is the transmit power level in dBm

Gtx is the transmit antenna gain in dB

FSL is the free space loss attenuation in dB, and

Grx is the receive antenna gain in dB

The FSL value is dependent on the range between the LB NI-01 Indoor units, the type of terrain over which the link is deployed, and whether or not the link is operating line of sight (LOS), optical line of sight (OLOS) or near-LOS (NLOS). The LOS FSL calculation is well understood and easy to calculate, and relies on the fact there is absolutely no obstacle near the direct path. The precise method for determining the amount of clearance required for LOS involves making use of a factor known as the Fresnel zone. A Fresnel zone is defined as a path difference of $\lambda/2$ away from the direct path, as shown in Figure 29. A "cleared LOS" link assumes there are no obstacles within 60% of the first Fresnel zone of the direct path. The

diagram below illustrates OLOS conditions, where a treetop is within the first Fresnel zone, and a clear direct path exists between the antennas.

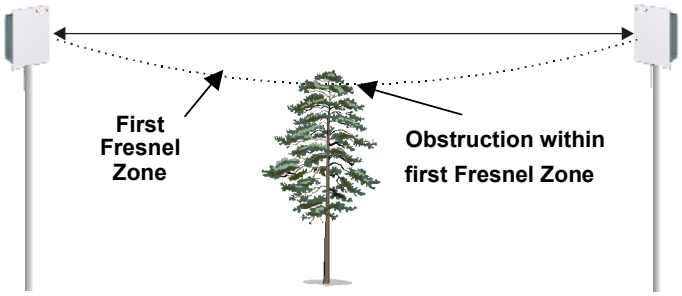


Figure 31: Fresnel Zone Obstruction

The formula for calculating the radius of the first Fresnel zone, as depicted in Figure 30, is given as:

$$R = 72.1\sqrt{\frac{D1 * D2}{f * (D1 + D2)}} \quad \text{(ft)}$$

Where,

D1 and D2 are the distances from the LB units to the point of interest (in miles); and,

f is the frequency (in GHz)

(Note: multiply results by 0.3048 to obtain a solution in meters)

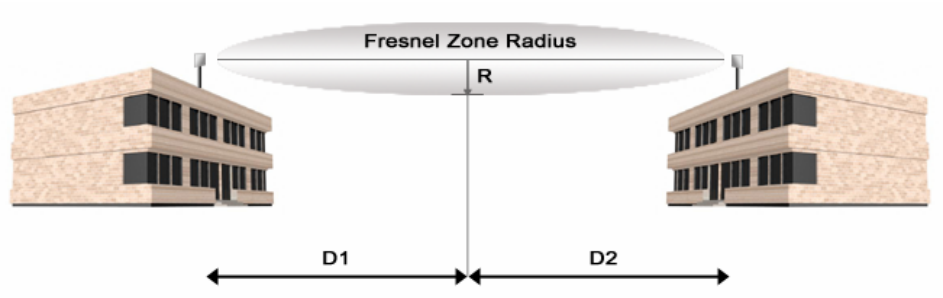


Figure 32: Fresnel Zone Radius Calculation

Specific FSL formulas are required to deal with this NLOS phenomenon. There are many NLOS calculations available from established institutions including the Institute of Electrical and Electronics Engineers (IEEE) and International Telecommunications Union (ITU), who are chartered with developing standardized calculations. The Alvarion Link Budget Tool is

built upon these formulas; however, it is important to bear in mind that the calculations are an estimate only, with relatively large standard deviations (5-15 dB) depending on the exact deployment scenario and obstacle characteristics.

The last element to consider in the path calculation is the signal to noise (S/N) ratio, which is defined as:

S/N = RSL – Smin

Where,

Smin is the receiver sensitivity expressed in dBm.

The Smin is determined by the thermal noise generated by the amplifier as well as the bandwidth of the filter used in the receiver front end. It defines the power level at which the receiver is sensitive enough to properly detect the signal. For the BreezeACCESS LB operating in a channel spacing of 20 MHz, the Smin is approximately –96 dBm.

To ensure the link is sufficiently robust to deal with unexpected attenuation effects and seasonal fades, the S/N must be set higher than the S/Nmin specified in Table 9. The difference between these two levels is called the Fade Margin (FM). FM is similar to a "power reserve", in which extra power is designed into the link budget to deal with additional fades arising from such factors as climatic conditions (seasonal), multipath dispersions, and shadowing effects from natural (foliage) and man-made obstacles (buildings). The FM is determined by the availability one desires. Availability is defined as the amount of time (expressed in % per year) that a link properly detects the signal. "Properly" in this case is a BER that is less than 10-9. The table below describes the outage period per year that corresponds to the different availability values.

Table 10: Availability versus Outage Time

Availability (%)	Outage Period Per Year
99.9	8.8 hours
99.99	53 minutes
99.999	5.3 minutes
99.9999	32 seconds

It is recommended that the link be designed for an availability greater than 99.99%. The tool automatically calculates the estimated required fade margin over distance to achieve this availability.

A key advantage of the Alvarion product is that it features a transmission correction scheme called Automatic Repeat Request (ARQ). The ARQ

algorithm essentially detects when a packet(s) has been lost, due to fading, and makes a request to the remote system to re-transmit the lost packet(s). This feature provides an equivalent link budget gain of over 5 dB, which translates directly to an improved margin.

Another key advantage of the Alvarion product is that it features dynamic adaptive modulation, i.e., the system selects the modulation scheme automatically on a burst-by-burst basis, based on the measured S/N response. In this manner, the network is constantly balanced for the optimum spectral efficiency, no matter what propagation conditions prevail. Higher order modulation schemes (e.g., 64 QAM) are typically deployed at reduced ranges while lower order modulation schemes (e.g., BPSK) are implemented at long distances.

A sample link budget is shown in Figure 33 for the BreezeACCESS LB system operating at 72 Mbps, providing a net burst throughput of 54 Megabits per second (Mbps). This provides an average throughput of 43 Mbps to the Ethernet port. The calculation is performed for LOS, however the tool graph (shown in Figure 32 below) also covers the OLOS and NLOS conditions.

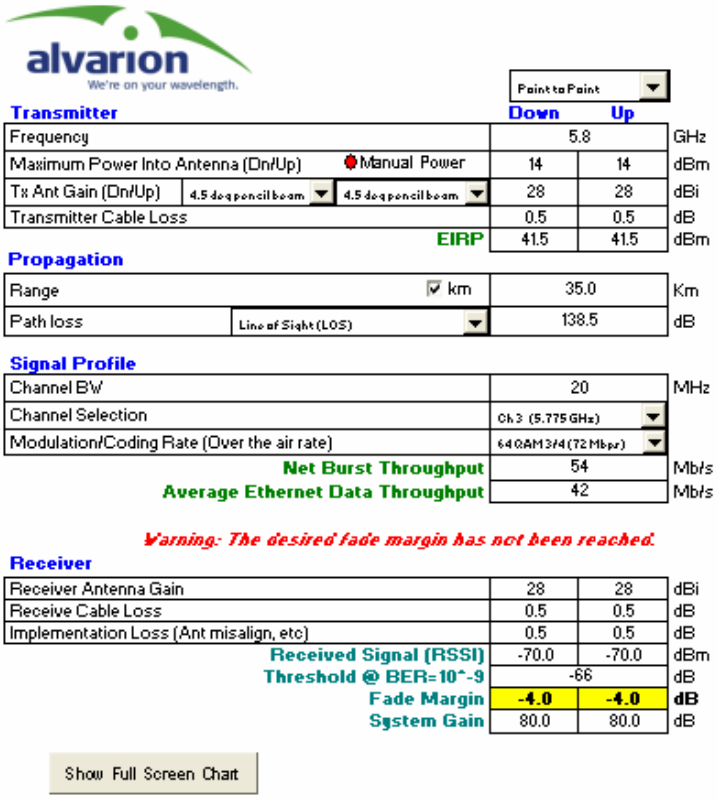


Figure 33: Link Budget For 64 QAM ¾ Code Rate

The fade margin graph for this link budget is given in Figure 33 for four conditions: LOS (a - blue line), OLOS with the first Fresnel zone obstructed

(b - red line), NLOS scattered trees and buildings (c - green line) and heavily treed residential NLOS (d - magenta line).

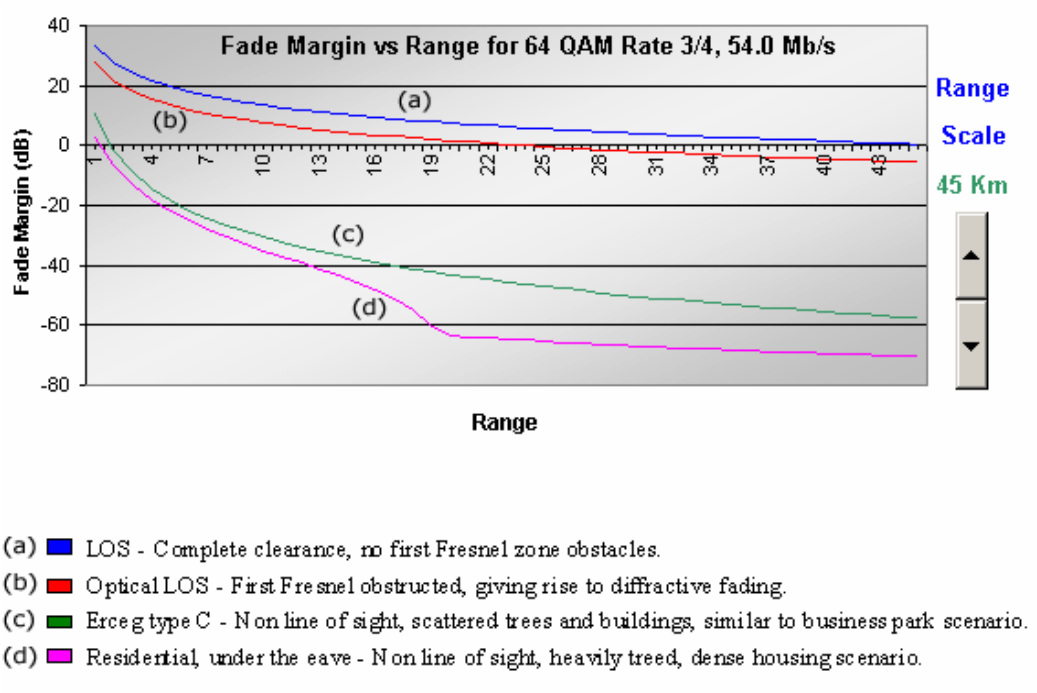


Figure 34: Fade Margin Graph LOS, OLOS and NLOS

The graph assumes a fade margin of 3 dB. The effects of rain at UNII bands are negligible, hence are not included in the link budget.

It is important to note the link calculation assumes that the Earth's curvature is not blocking the propagation path. The equation for determining the distance at which the Earth will cause blockage is called the Radar Horizon, and is given as follows:

$$\mathbf{R_h} = 4.1(\sqrt{h_1} + \sqrt{h_2}) \quad \textbf{(km)}$$

where,

h1 is the height of terminal 1 (m)

h2 is the height of terminal 2 (m)

The table below specifies the horizon distance (km) that can be achieved for different terminal heights ranging from 10 to 70 m above mean terrain level.

Table 11: Radar Horizon Ranges, Different Terminal Heights H1 & H2

H1 \ H2	10	20	30	40	50	60	70
10	25.9	31.3	35.4	38.9	42.0	44.7	47.3
20	31.3	36.7	40.8	44.3	47.3	50.1	52.6
30	35.4	40.8	44.9	48.4	51.4	54.2	56.8
40	38.9	44.3	48.4	51.9	54.9	57.7	60.2
50	42.0	47.3	51.4	54.9	58.0	60.7	63.3
60	44.7	50.1	54.2	57.7	60.7	63.5	66.1
70	47.3	52.6	56.8	60.2	63.3	66.1	68.6

Deployment Scenarios

This section examines two types of deployment scenarios: co-located (same rooftop), and adjacent area.

Co-located Deployments

It is possible to deploy more than one BreezeACCESS LB system from the same rooftop to support multiple links, however, it is important to consider issues that may arise from co-channel and adjacent channel interference.

Co-channel interference results when two systems operate simultaneously in the same channel. This must be avoided by selecting different channels in the BreezeACCESS LB Configuration screen. Adjacent channels are acceptable; however, it is important that the adjacent channel does not exceed the acceptable channel-to-interference (C/I) ratio for the system, as shown in Figure 35 (C is the desired channel, while I is the interferer).

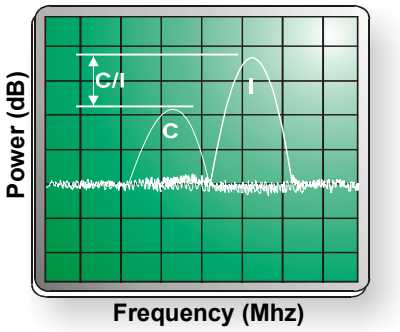


Figure 35: Adjacent Channel Interference.

Adjacent Area Deployments

During the installation process, it is important to ensure there is no potential for interference from other systems deployed in adjacent areas. Figure 36 presents a simple deployment configuration to illustrate the potential interference that may arise from adjacent area sources (Users 1 to 4 in Figure 36).

The desired communication link is between Terminal 1 and 2. The link between Users 1 and 2 must operate in an adjacent channel to avoid interference with the desired link. Users 3 and 4, on the other hand, can operate co-channel since they are outside the narrow beam width of both LB NI-01 Indoor units. Narrow beam widths are one feature of the BreezeACCESS LB to help address potential interference.

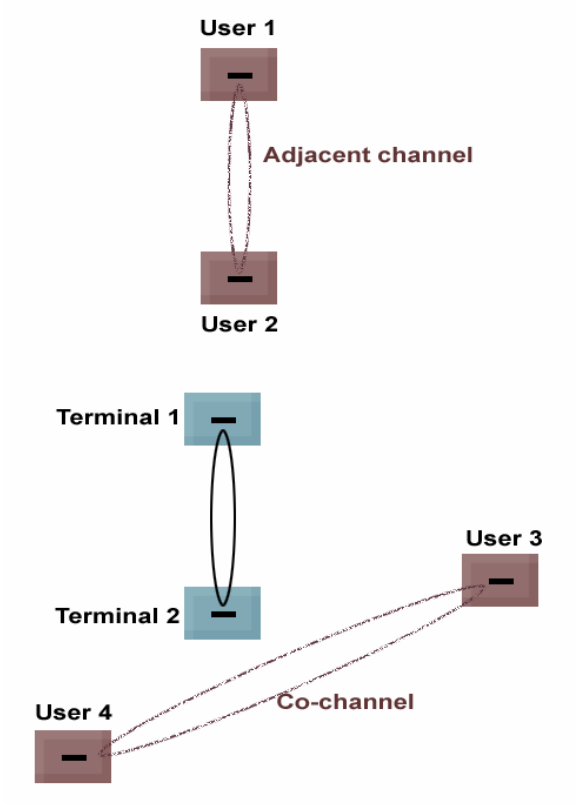


Figure 36: Deployment Scenarios

Appendix A
Glossary of Terms

Antenna	A device for transmitting and/or receiving a radio frequency (RF). Antennas vary in design and frequencies supported.
Antenna Gain	The measure of antenna performance relative to a theoretical antenna called an isotropic antenna.
AGC	Automatic Gain Control.
ARQ	Automatic Repeat Request. This is the protocol used over the air for error correction.
Beamwidth	The angle of signal coverage provided by an antenna.
BFW	Broadband Fixed Wireless
Bps (Bits Per Second)	A unit of measurement for the rate at which data is transmitted.
BPSK	Binary Phase Shift Keying.
BreezeACCESS LB	Alvarion Communications Broadband Fixed Wireless (BFW) system.
Channel	A communications path wide enough to permit a single RF transmission.
dB	A ratio expressed in decibels.
dBi	A ratio, measured in decibels, of the effective gain of an antenna compared to an isotropic antenna.
dBm	Decibels in milliwatts
DHCP	Dynamic Host Configuration Protocol. A DHCP server will automatically issues IP addresses within a specified range to devices on a network.
Directional Antenna	An antenna that concentrates transmission power into one direction.
Encryption	For the purposes of privacy, the transformation of data into an unreadable format until reformatted with a decryption key.
Ethernet	A LAN architecture using a bus or star topology
FD	Full Duplex. Refers to the transmission of data in two directions simultaneously (i.e. a telephone)

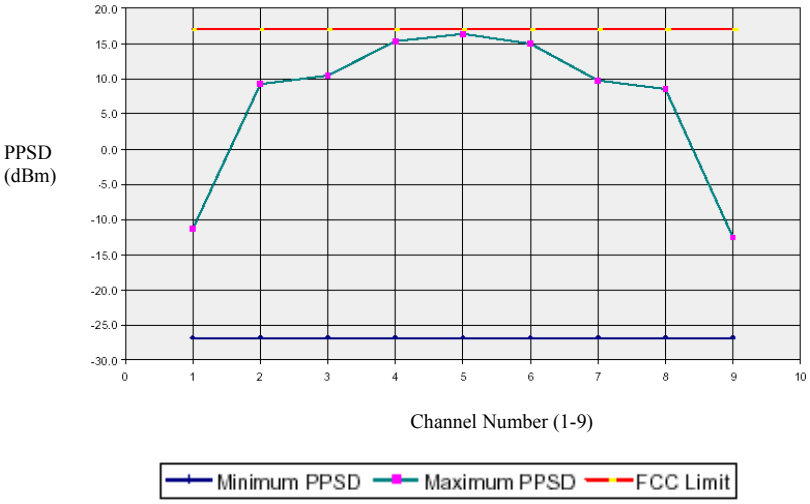
FWA	Fixed Wireless Access
Gain	The ratio of the output amplitude of a signal to the input amplitude of a signal. Typically expressed in decibels (dB).
Gateway	A network point that acts as an entrance to another network.
GHz	Gigahertz. 1,000,000,000 Hz, or 1,000 MHz
GUI	Graphical User Interface
Hertz (Hz)	The international unit for measuring frequency, equivalent to the number of cycles per second. One megahertz (MHz) is one million Hertz. One gigahertz (GHz) is one billion Hertz.
IF	Intermediate Frequency.
IP (Internet Protocol)	See TCP/IP.
Isotropic	A theoretic construct of an antenna that radiates its signal 360 degrees both vertically and horizontally - A perfect sphere. Generally used as a reference.
IXC (Inter-exchange Carrier)	A long-distance phone company.
LAN (Local Area Network)	A data communications network, typically within a building or campus linking computers, printers and other devices together.
LEC (Local Exchange Company)	The traditional local wired phone company.
LED	Light Emitting Diode
LOS	Line Of Sight. A clear direct path between two antennas, with no obstructions within the first Fresnel zone.
MAC (Media Access Control)	A unique number assigned to a network device. It corresponds to the ISO Network Model Layer 2 data link layer.
MHz	Megahertz. 1,000,000 Hz
Modem (MOdulator/DEModulator)	A hardware device that converts digital data into analog and vice versa.
Modulation	Any of several techniques for combining user information with a transmitter carrier signal.
Multipath	The radio echoes created as a radio signal bounces off of objects.
NLOS	Near Line Of Sight. Completely obstructed path between two antennas.

OFDM	Orthogonal Frequency Division Multiplexing. OFDM spreads data to be transmitted over a large number of orthogonal carriers.
OLOS	Optical Line Of Sight. A clear direct path between two antennas, with obstructions within the first Fresnel zone.
Packet	A bundle of data organized in a specific way for transmission. The three principal elements of a packet include the header, the text, and the trailer (error detection and correction bits).
PHY (Physical Layer)	Provides for the transmission of data through a communications channel by defining the electrical, mechanical, and procedural specifications.
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Receiver Sensitivity	A measurement of the weakest signal a receiver can receive and still correctly translate it into data.
RF	Radio Frequency
Rx	Receiver
S/N	Signal to Noise Ratio
SINADR	Signal to noise and distortion ratio.
TCP/IP (Transmission Control Protocol/Internet Protocol)	The standard set of protocols used by the Internet for transferring information between computers, handsets, and other devices.
TFTP	Trivial File Transfer Protocol
Tx	Transmitter
UNII	Unlicensed National Information Infrastructure

Appendix B

Peak Power Spectral Density

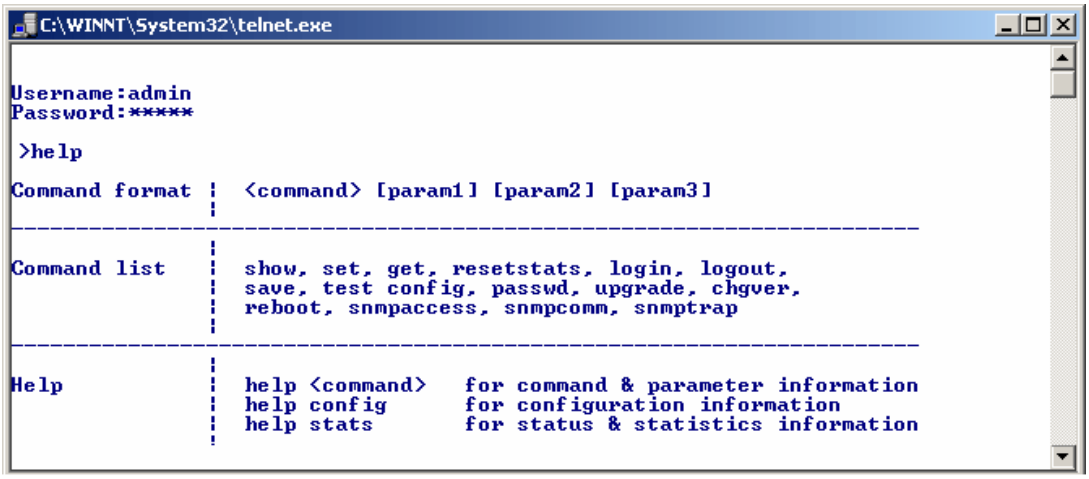
Power spectral density as measured for the BreezeACCESS LB system.



Appendix C
CLI Commands

CLI Commands

The following commands are available via Telnet and Console connections to the LB NI-01 indoor unit, as outlined in previous Sections. For online help, type 'help <command>' at the command prompt.



General Commands

Command	Description
chgver	Swaps the operating and secondary software versions
get	Get <parameter name> displays the value for a status parameter. For configuration parameters, use Set command.
login	Allows login under a different username and password
logout	Disconnects user from the terminal.
passwd	Change password for user. passwd <username> <newpassword>
reboot	Reboots the terminal. Reboot <time in seconds>
resetstats	Resets all statistics
save config	Permanently saves system configuration settings. This command is required to activate all Configuration settings set previously
save snmp	Permanently saves SNMP configuration settings. This command is required to activate all SNMP settings set previously.

set	Set one configuration parameter: <parameter name> [<value>] Without <value>, 'set' returns the actual value for configuration parameters. For status parameters, use the Get command.
show config	Returns a list of all System Configuration parameters.
show log	Returns a list of current system log entries.
show snmp	Returns a list of all SNMP communities and related parameters.
show stats	Returns a list of all System Status parameters.
snmpaccess	Modify access rights for a community (see snmpcomm) snmpaccess <community name> <access>
snmpcomm	To add a new SNMP community: snmpcomm add <community name> <access> <access> can be: "r","w","t" or any combination To delete an SNMP community snmpcomm del <community name>
snmptrap	To add a trap destination for an SNMP community: snmptrap add <community name> <IP destination> To delete a trap destination for an SNMP community: snmptrap del <community name> <IP destination>
test config	Allows testing of configuration settings for 5 minutes, after which the system reverts to the previously saved settings. To make settings permanent use 'save' command.
upgrade	Begin a software upload. upgrade <ipaddr> <filename>

General Information

Command	Description
gateway	Specifies the IP address of the default router
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
macaddr	Specifies the Ethernet MAC address used by local terminal
master	Indicates whether the system is serving as master or slave
rflink	Yes: RF link up / No: RF link down
starttime	Specifies the time elapsed since the system started
swver	Specifies the operating software version

sysdetails	Specifies the location, telephone #, contact information, etc.
sysname	Identifies the local terminal
ubrate	Indicates the system's current uncoded burst rate

System Status

Command	Description
cableattn	The attenuation of the signal over the IF cable
erxpkt	Counts the number of packets successfully received locally
erxpktd	Counts the number of packet errors received locally
etxpkt	Counts the number of Ethernet packets transmitted
gateway	Specifies the IP address of the default router
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
macaddr	Specifies the Ethernet MAC address used locally
master	Indicates whether the system is serving as master or slave
resetstats	Resets all statistics
rffreq	The center frequency of the channel in use
rflink	Yes: RF link up. No: RF link down
rfstatus	An error code (0-31), indicating the RF status
rssimax	The maximum received signal strength
rssimean	The average received signal strength
rssimin	The minimum received signal strength
sinadr	The no. of successful wireless pkt. received over the air
swver	Specifies the operating software version
sysname	Identifies the local terminal
txpower	The actual current transmit power level
ubrate	Indicates the system's current uncoded burst rate
wrxpkt	The no. of successful wireless pkt. received over the air
wrxpktd	The no. of wireless pkt. received with errors over the air
wrxpktr	The no. of wireless pkt. retransmitted over the air
Wtxpkt	The no. of wireless pkt. successfully transmitted over the air

wtxptd	The no. of transmitted pkt. discarded by the remote terminal
wtxpktr	The no. of wireless pkt. retransmitted over the air

System Configuration

Command	Description
adaptmod	Enables Adaptive Modulation mode.
buzzer	Specifies whether the antenna buzzer is enabled
chgver	Change the operating software version
encrypt	Specifies whether over-the-air data encryption is enabled
encryptkey	Enter the remote terminal's MAC address if encryption is enabled
flowctrl	Specifies whether flow control on the Ethernet port is enabled
gateway	Specifies the IP address of the default router
http	Specifies whether configuration over HTTP is enabled
ipaddr	Specifies the IP address used by the local terminal
ipmask	Specifies the IP Subnet Mask used by the local terminal
macaddr	Specifies the Ethernet MAC address used by the local terminal
master	Indicates whether the system is serving as the master or slave
modreduct	Used when 'AdaptMod' is disabled.
radio	Specifies whether radio transmission is enabled
reboot	Reset all statistics and reboot the terminal
rfchannel	Available channel options: 1, 1A, 2, 2A, 3, 3A, 4, 4A, 5.
save config	Permanently saves configuration settings
snmp	Specifies whether configuration over SNMP is enabled
sysdetails	Specifies the location, telephone #, contact information, etc.
sysname	Identifies the local terminal
telnet	Specifies whether configuration over telnet is enabled
telnetport	Specifies the TCP port used for telnet
test config	Allows testing of new settings for 5 minutes, after which system reverts to previously saved settings. Use 'Save' for permanent settings.
txpower	Specifies the max. power level of the system
Ubrate	Sets the desired burst rate for the link.

Appendix D

Support for TDM using Third Party Units

Support For TDM Using Third Party Units

802.1p

The BreezeACCESS LB uses IEEE 802.1p to ensure QoS to TDM based applications such as mobility backhaul and enterprise PBX traffic. IEEE 802.1p allows the wireless transmit queue to be split into two (high and low priority) queues. Ethernet packets are queried to determine if they are priority tagged. Packets tagged with a priority value greater than or equal to four are automatically placed in the high priority queue. All other packets go into a default queue. The LB always services the traffic in its high priority queue before the default, low priority queue. A low priority packet will only be transmitted once the high priority queue is empty.

Flow Control

For improved traffic handling the BreezeACCESS LB supports standard IEEE 802.3x flow control.

Upon reception of a pause control frame, the Ethernet port will not transmit the next normal frame until the timer specified in the pause control frame expires, or another pause control frame is received. During the flow controlled period, only flow control packets will be transmitted between the LB and its interfacing device (i.e. Switch/ Router or Third Party T1/E1 Unit).

The LB will also transmit pause control frames based on the availability of its own internal resources, including buffers, transmit queues and receive queues.

Ethernet traffic can easily exceed the total capacity of a wireless link and thereby trigger indiscriminate packet discarding on all traffic streams. To avoid this condition the LB also provides a dynamic traffic shaping capability that continually adjusts itself to the current wireless throughput conditions. With adaptive modulation enabled, wireless throughput can automatically decrease, in order to maintain acceptable Packet Error

Rates. In response to such a decrease, the LB will also automatically throttle-back (traffic shape) the lower priority traffic streams by first discarding the packets in its default Tx queue.

Upon receiving additional packets, the LB will issue a pause control frame to its interfacing device, requesting a pause in transmission.

Once wireless resources are again freed up, a new pause control frame is issued to resume transmission.

Using a Third Party T1/E1 Unit with BreezeACCESS LB

While it is beneficial for the interfacing device to support 802.3x (i.e. interpret and act on pause frames issued by the LB) in data only applications, it is essential that the Third Party T1/E1 Unit be configured to ignore the reception of 802.3x pause frame in order to ensure uninterrupted transmission of the TDM traffic.

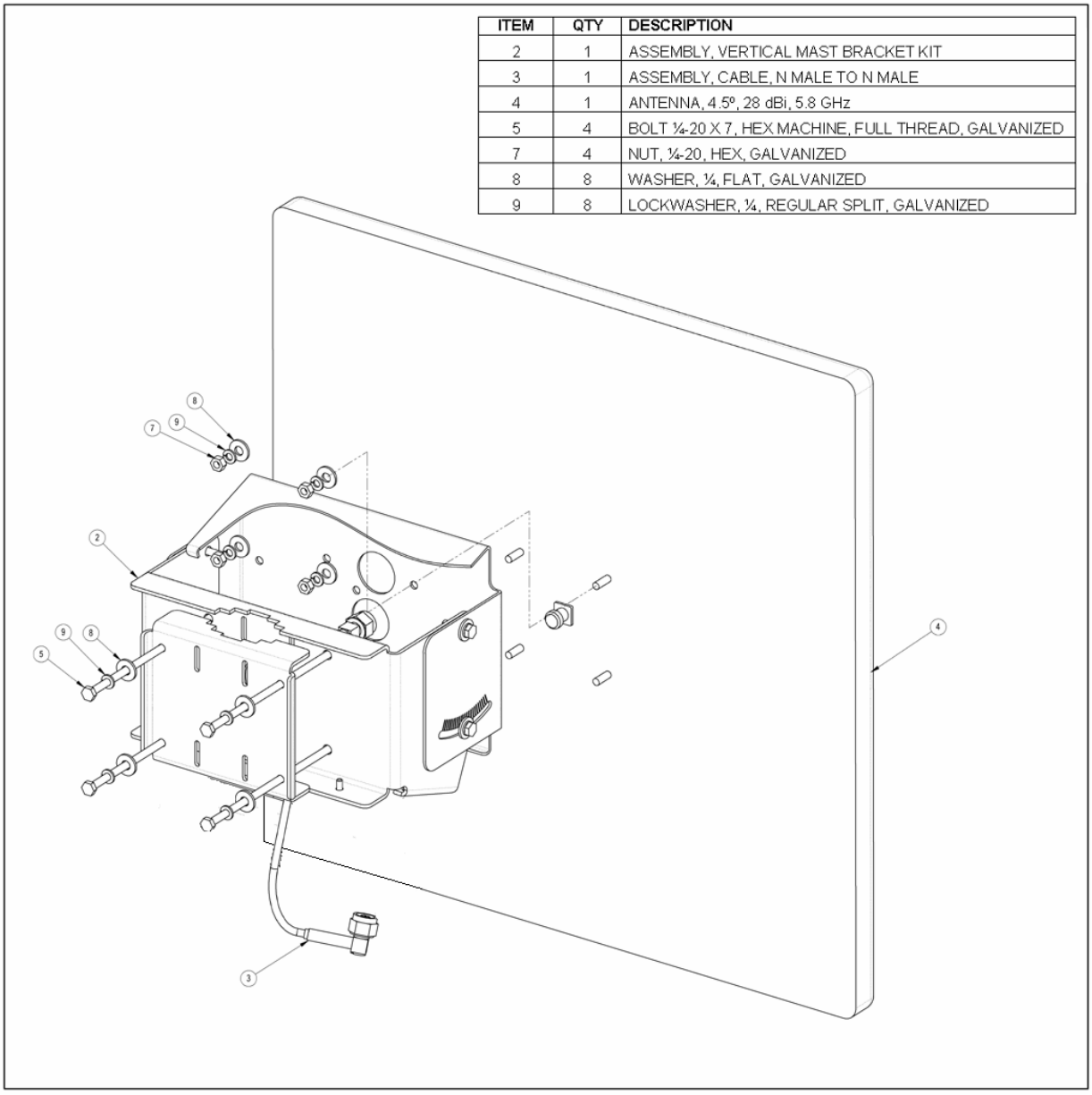
Note: For more information, contact your Alvarion certified partner or system integrator or check our support site for additional TDM documents.

Appendix E

Antenna Assembly

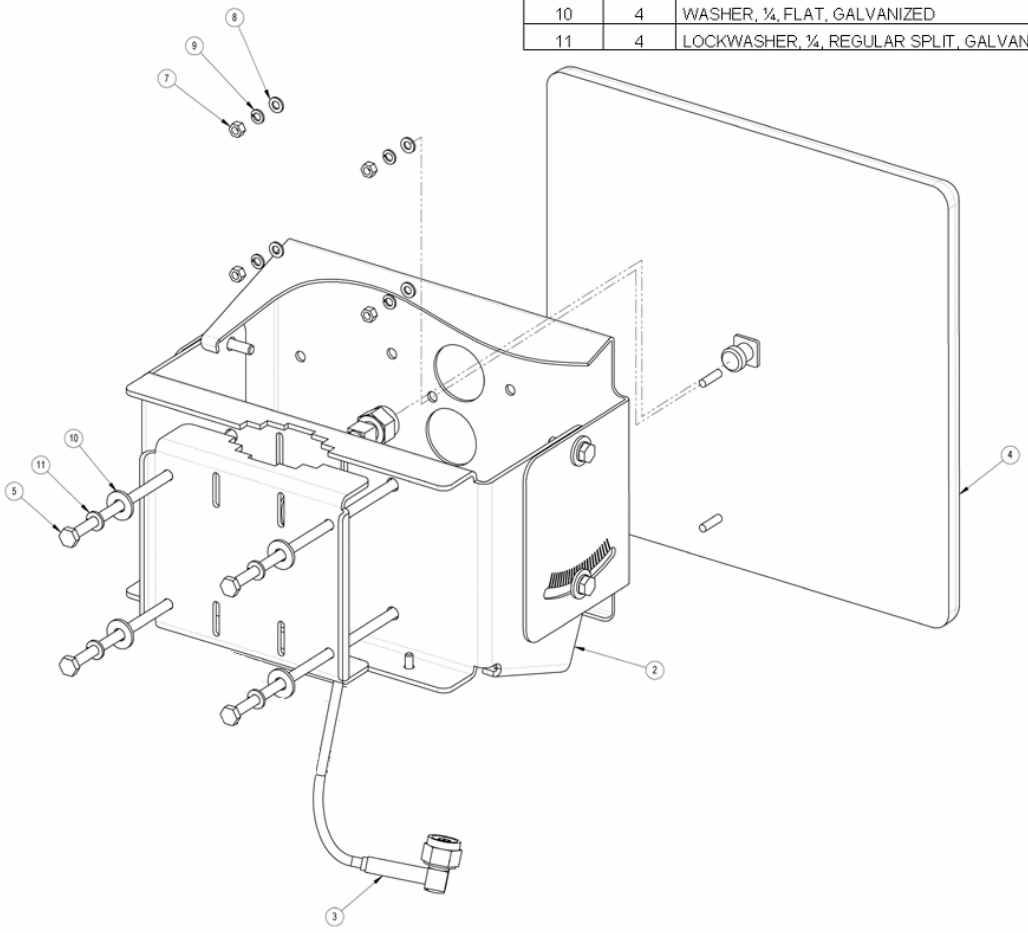
28 dBi, 4.5º Antenna - Vertical Mount Assembly

ITEM	QTY	DESCRIPTION
2	1	ASSEMBLY, VERTICAL MAST BRACKET KIT
3	1	ASSEMBLY, CABLE, N MALE TO N MALE
4	1	ANTENNA, 4.5º, 28 dBi, 5.8 GHz
5	4	BOLT ¼-20 X 7, HEX MACHINE, FULL THREAD, GALVANIZED
7	4	NUT, ¼-20, HEX, GALVANIZED
8	8	WASHER, ¼, FLAT, GALVANIZED
9	8	LOCKWASHER, ¼, REGULAR SPLIT, GALVANIZED



23 dBi, 9º, Antenna - Vertical Mount Assembly

ITEM	QTY	DESCRIPTION
2	1	ASSEMBLY, VERTICAL MAST BRACKET KIT
3	1	ASSEMBLY, CABLE, N-Type MALE TO N-Type MALE
4	1	ANTENNA, 9º, 23 dBi, 5.8 GHz
5	4	BOLT ¼-20 X 7, HEX MACHINE, FULL THREAD, GALVANIZED
7	4	NUT, M5, STANDARD, S.S.
8	4	WASHER, M5, FLAT, S.S.
9	4	LOCKWASHER, M5, SPLIT, S.S.
10	4	WASHER, ¼, FLAT, GALVANIZED
11	4	LOCKWASHER, ¼, REGULAR SPLIT, GALVANIZED



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www.alvarion.com

BreezeACCESS LB

Accelerating your access

International Corporate Headquarters

Alvarion Ltd.
HaBarzel 21a
Tel Aviv 69710, Israel
Tel: +972 3 645 6262
Fax: +972 3 645 6222
Email: corporate-sales@alvarion.com

North America Headquarters
Alvarion Inc.
5858 Edison Place
Carlsbad, CA 92008
Tel: (760) 517 3100
Fax: (760) 517 3200
Email: n.america-sales@alvarion.com

Alvarion Worldwide Offices:

Latin America & Caribbean
7497 W. Oakland Park Blvd.
Suite 304
Lauderhill, FL 33319 USA
Tel: +1 954 746 7420
Fax: +1 954 746 9332
Email: lasales@alvarion.com

Asia Pacific
Room 2603, 26/F
Laws Commercial Plaza
788 Cheung Sha Wan Road
Kowloon Hong Kong
Tel: +852 2786 9996
Fax: +852 2310 0062
Email: far.east-sales@alvarion.com

China
Rm. 803, Tower 1,
Bright China Chang An Building, No. 7
Jianguomen Nei Avenue
Beijing 100005 China
Tel: +86 10 6510 2800
Fax: +86 10 6510 2803
Email: china-sales@alvarion.com

Japan
Bureau Toranomon # 1004
2-7-16 Toranomon, Minato-ku,
Tokyo 105-0001, Japan
Tel: +81 3 3506 7616
Fax: +81 3 3506 7616
E-mail: alvarion-japan@alvarion.com

France
Le Saint James
3 Chemin de la Dime
95700, Roissy en France
Tel: +33 1 34 38 54 30
Fax: +33 1 34 38 54 39
Email: france-sales@alvarion.com

Germany
Landsberger str. 302
80687 Munich Germany
Tel: +49 89 90405 923
Fax: +49 89 90405 922
Email: germany-sales@alvarion.com

U.K. & Ireland
15 Liberty House
New Greenham Park, Newbury
Berkshire, RG19 6HW England
Tel: +44 845 450 1414
Fax: +44 845 450 1455
Email: uk-sales@alvarion.com

Czech Republic
Detsky Dum
Na Prikope 15
110 00 Praha 1 Czech Republic
Tel: +420 222 191 233
Fax: +420 222 191 200
Email: czech-sales@alvarion.com

Brazil
Av. Brigadeiro Faria Lima, 1685
1st Fl., room 1C
Sao Paulo 01452-001 Brazil
Tel: +55 11 3815 6225
Fax: +55 11 3813 0467
Email: brazil-sales@alvarion.com

Uruguay
Br. Espana, 2586
Montevideo 11300 Uruguay
Tel: +598 2 712 3210
Fax: +598 2 712 3211
Email: lasales@alvarion.com

Russia
16, bld. 47, 3-th Mutishinskaya str.
floor 11, office 1101,
129626 Moscow, Russia
Tel: +7 (095) 737-88-06
Fax: +7 (095) 287-9899
Email: russia-sales@alvarion.com

Romania
1 Natiunale Unite Blv.,
Bld. 108A, 2nd floor
Bucharest 705052 Romania
Tel: +40 1 335 7631
Fax: +40 1 335 7634
Email: romania-sales@alvarion.com